

# Tanzanian mushrooms and their uses 1. *Russula*

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A brief introduction of the project on Tanzanian edible mushroom is given along with the main features of the soil and vegetation of the collecting sites. The importance of Russulaceae in Africa and the collected *Russula* species are discussed. Thirty-six specimens of *Russula* were collected between 1989–1991, and of this material, 21 species of *Russula* were identified. Nineteen species are reported from Tanzania for the first time. *R. tenuithrix* Buyck sp. nov., *R. tanzaniae* Buyck sp. nov., *R. hiemisilvae* Buyck sp. nov., *R. sublaevis* (Buyck)Buyck stat. nov. and nine other species were found in woodlands, *R. usambarae* Buyck sp. nov., *R. acriannulata* Buyck sp. nov. and five other *Russula* in lower montane forest. One species has been introduced in *Pinus* plantations. Along with a key to the collected *Russula* species, their systematic position, distribution and possible host trees are discussed and compared with earlier data from Tanzania and other African countries. A discussion on the edibility of *Russula* is also included.

Key words: Africa, Agaricales, ethnomycology, *Russula*, Tanzania, taxonomy

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## Introduction

In modern times rapid urbanization and loss of the traditional way of living are in progress all over the world. Collection of ethnobotanical knowledge regarding native people is an urgent task. No work has been done thus far in Tanzania concerning use of mushrooms.

Tanzania lies in eastern Africa between latitudes 1–11° south of the Equator (see Fig. 4). Its area is about 945 000 sq km. Hot and humid tropical lowlands are found along the coast, but a major part of the country consists of high plateau at the altitude of ca. 1 000 m, which is cool during the rainy seasons. There are also mountains with all climatic zones up to regions of permanent ice on Mt Kilimanjaro. The leeward western sides of the mountains are mostly arid, because prevailing winds blow from the Indian Ocean in the east. There are two rainy seasons in northern Tanzania,

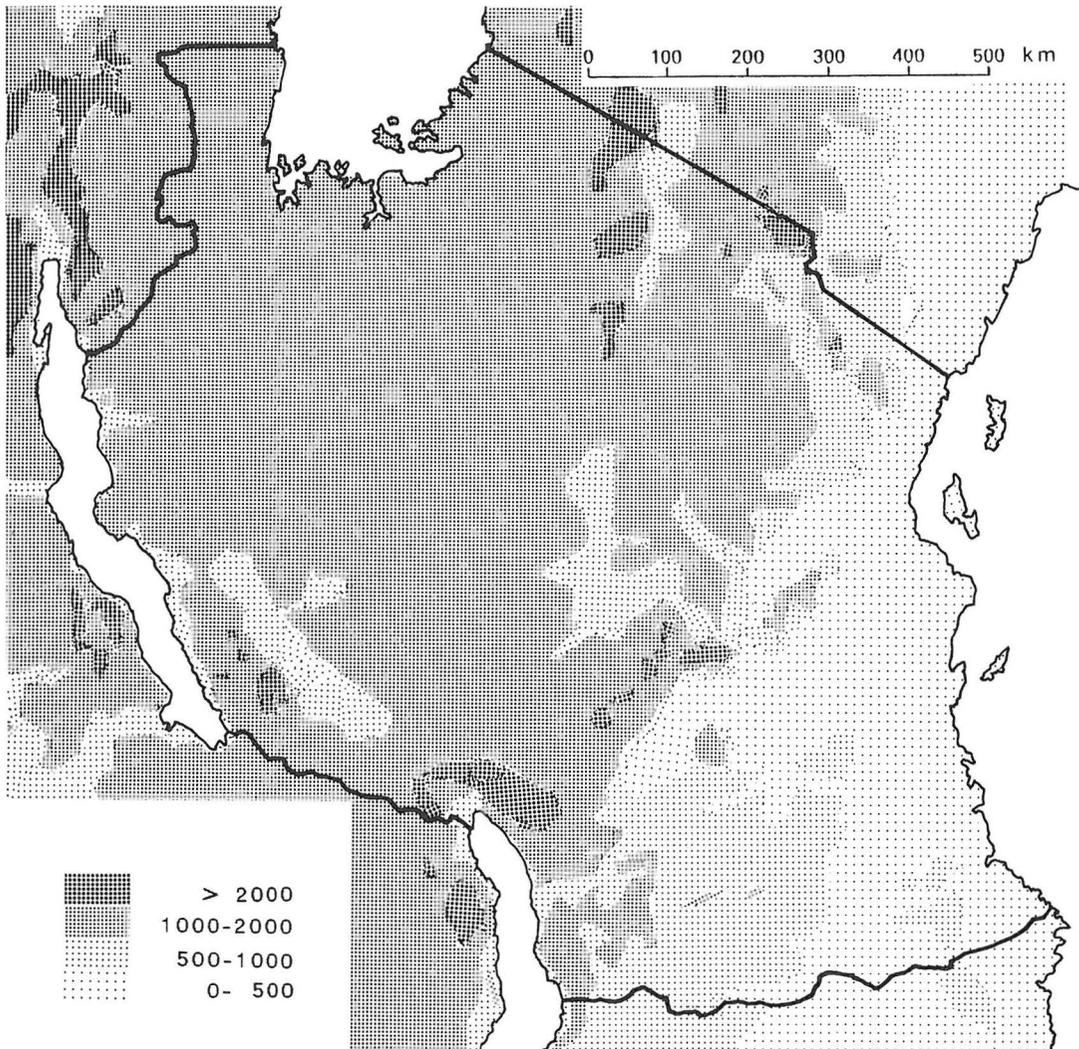


Fig. 1. Tanzania. Altitude, meters above sea level. All maps compiled from Berry (1975), Anonymous (1987) and White (1983).

the so-called short rains in November–December and long rains in April–May. South-eastern slopes of the mountains may get rains any time of the year. As for southern Tanzania, it has only one rainy season, which usually begins in January. Because of the varying topography and climate there is a wide variation in vegetation from rain forests to semideserts (see Figs. 1–3).

The population of Tanzania is about 24 million (Anonymous 1990), with about 120 tribes, each of which has a language of its own (Berry 1975). The largest of these is Sukuma, comprising about 12% of the population; none of the others exceeds 4%. In addition to their mother tongue, most people can speak Swahili, and many even English, the two official languages.

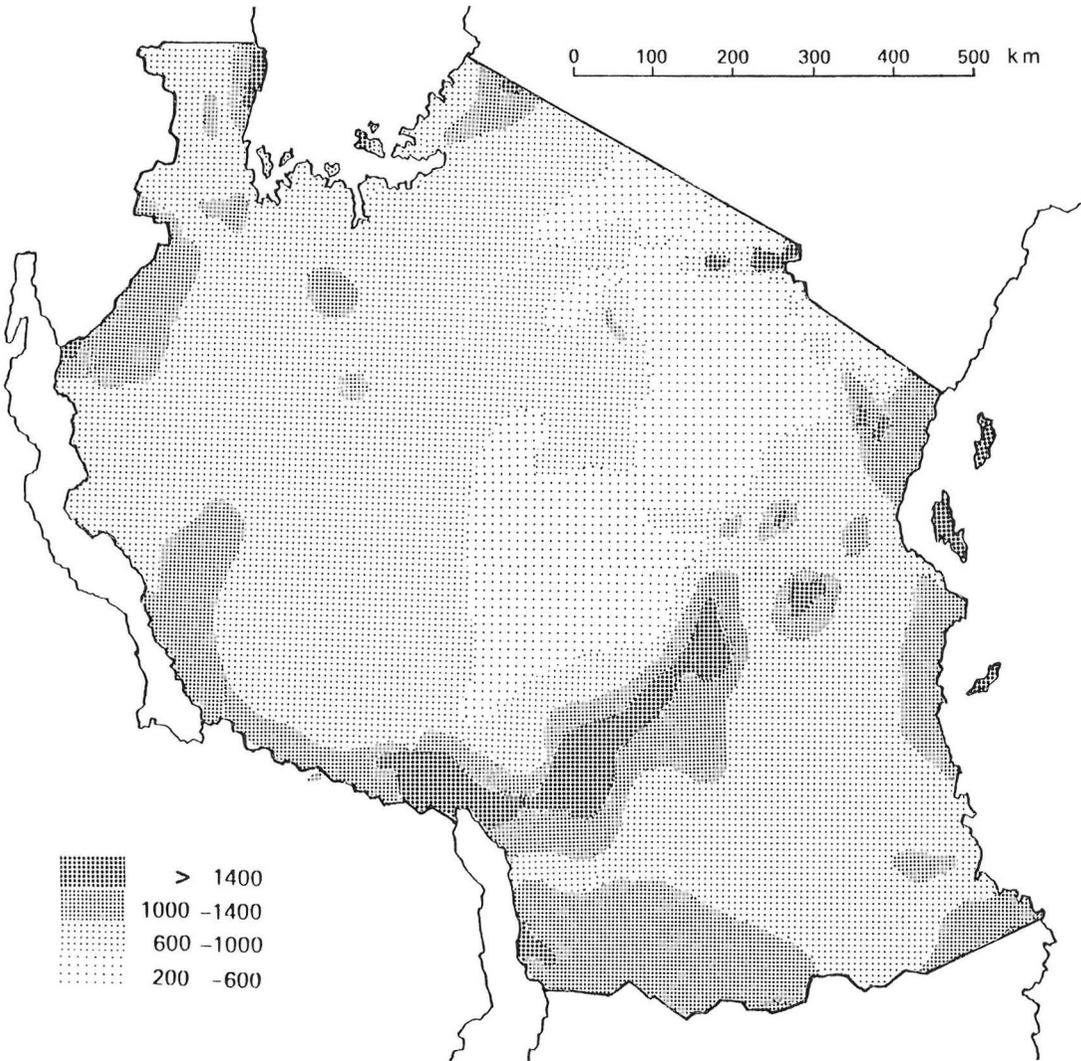


Fig. 2. Tanzania. Average annual precipitation in millimeters.

After some preliminary inquiries during three field expeditions in 1988 and 1989 a research project on Tanzanian edible mushrooms and their uses was set up in 1990 jointly with the University of Helsinki in Finland and the University of Dar es Salaam in Tanzania. For more details about the framework of this research, see Härkönen et al. (1993a, b).

In this paper Härkönen and Saarimäki have

written the following chapters: Introduction, Material and methods, and Edibility. Buyck is responsible for the chapter *Russula*, and Mwasumbi for Habitats of *Russula* in Tanzania. The discussion has been compiled by the first three authors. Line drawings referred to in the descriptions were done by Buyck, SEM photos by Salo and Saarimäki, and other photos and maps by Härkönen and Saarimäki.

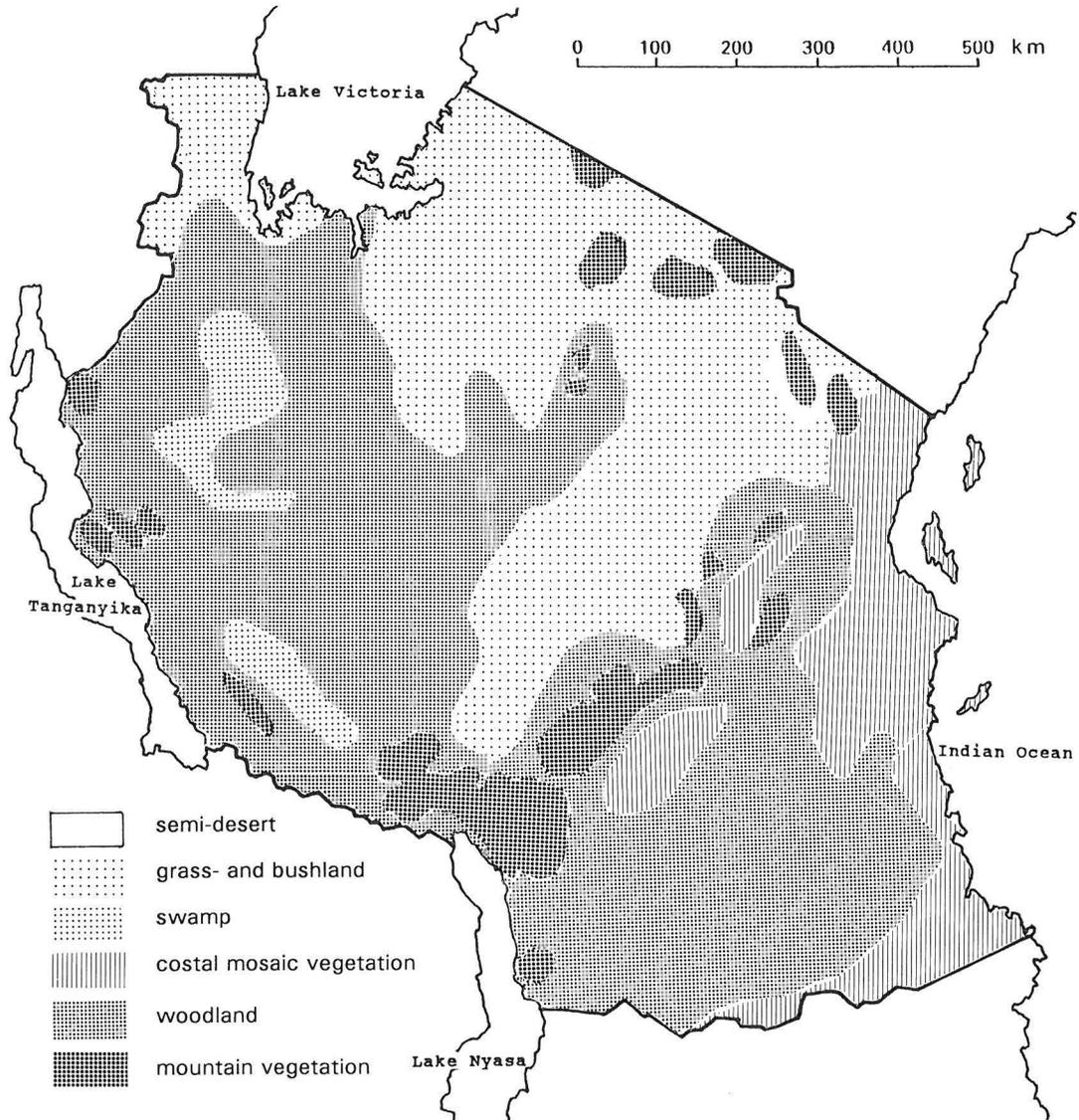


Fig. 3. Tanzania. Generalized distribution of original vegetation.

## Material and methods

### Collecting

To determine habits of mushroom use, the authors Härkönen and Saarimäki from Finland and Mwasumbi from Tanzania made three collecting trips to Tanzania in 1990 and 1991, all during the rainy seasons. Fig. 4 shows the areas of the tribes visited thus far. One further field expedition will be made in 1993.

In villages we contacted local people and went with them to pick mushrooms. Afterwards we collected vernacular names for the mushrooms from the villagers, interviewed them and studied how mushrooms were prepared for food. When possible, we also ate mushroom dishes ourselves. Voucher specimens were preserved, their fresh characters were recorded, and they were dried with a field drier to be later identified at the University of Helsinki. Mushrooms were also purchased for specimens along roadsides and in market places.

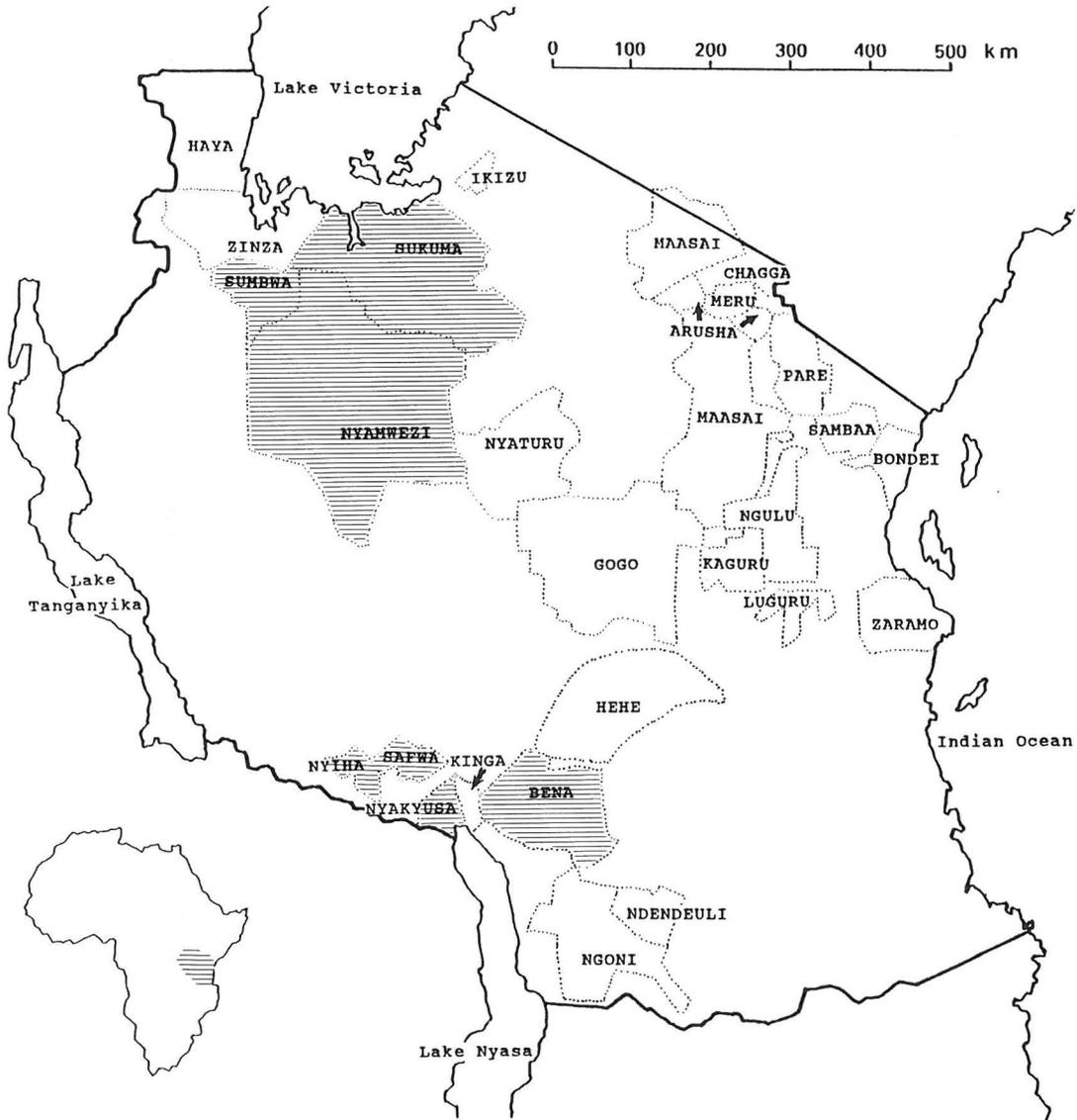


Fig. 4. Map showing distribution of the tribes visited during the first three collecting trips. Shaded areas show tribes which use *Russula* species for food.

**Interviews**

Interviews were held in Swahili or in English or in some cases in local languages. To standardize the information collected from different tribes, the same set of questions was always asked as follows:

Personal details: Name, address, sex, age, tribe, vernacular language, occupation, length of time the family has lived in the area.

Specific questions: Do you eat mushrooms? Do you

collect mushrooms yourself or who in your family collects them? Who taught you how to collect them? How many different kinds of mushrooms do you collect for food? Please list the names of the mushrooms now on hand or tell us what species you can recognize. Which species tastes the best? Is everyone here allowed to collect mushrooms everywhere? When and how often are the mushrooms collected? How do people prepare mushrooms for food? Who in your family prepares mushrooms for food? How highly do you value mushrooms as food if compared to

other foodstuffs such as meat, fish or vegetables? Do you preserve mushrooms? How? Which species? Are mushrooms offered for sale in the market places in this region? Do you use mushrooms for other purposes than for food, for instance as medicine? Is there a traditional healer in your village who uses mushrooms? How does he use them? Are there poisonous mushrooms in this region? Have misidentifications occurred, leading to mushroom poisonings? How do you recognize a poisonous mushroom? Do you know any beliefs, stories or fairy-tales about mushrooms?

So far 81 interviews have been held and transcribed from the recorded tapes and field notes. They are included in full in the first two progress reports for the Finnish International Developmental Agency of the Ministry for Foreign Affairs of Finland (FINNIDA) and for the Tanzanian Commission for Science and Technology. Some preliminary conclusions about mushroom-use by the Tanzanians have been compiled by Härkönen (1992) and Härkönen et al. (1993b).

### Handling of the material

During all our trips we have collected about 1 000 specimens of fungi, edible and also inedible ones. In the text collecting sites are according to Polhill (1988) and the Degree Reference System is according to Leistner & Morris (1976). All specimens are deposited at the Botanical Museum of the University of Helsinki (H). One article on the Myxomycetes has already been published (Härkönen & Saarimäki 1991, 1992).

All specimens considered by the natives to be edible have been identified to genus level by the first and third authors. The identification is continued to the species level and results will be published gradually, if possible jointly with the aid of specialists in specific groups. In August, 1992, Bart Buyck, a specialist in African Russulaceae, visited the University of Helsinki to work on the 36 *Russula* specimens collected from Tanzania thus far.

## Russula

### Introduction

*Russula* is the type genus of the Russulaceae Lotsy. In its classic concept, this family comprises the agaricoid genera *Lactarius* and *Russula*, the former differing in the field principally by the exudation of a milky latex on injury, the usually decurrent lamellae and the quasi absence of brightly coloured basidiomes. The Russulaceae differ from the other lamellate Basidiomycotina (Agaricales) by having spherocytes in the context. These spherocytes also explain the brittle, not fibrous nature of the flesh of the Russulaceae. Several taxa producing secotoid or hypogeous basidiomes (Elasmomycetaceae sensu Pegler & Young) or even

poroid basidiomes (Bondarzewiaceae Kotl. & Pouzar) have been linked with the Russulaceae because of their similar spherocytes, the possession of amyloid ornamentation on the spores or sulfoaldehyde-sensitive (sulfovanilline [SV] is most used) cystidia or laticifers, which are all characteristic features of the Russulaceae.

Study of the Russulaceae requires several reagents for macroscopic and microscopic examination. The morphological diversity of microscopic structures has given rise to a rich terminology. We refer to Romagnesi (1967, 1985), Singer (1986) and, particularly for the tropical species, to Buyck (1989a, 1991a, b) for explanation of the use of reagents and the methodology of examination.

Although microscopic features have become more important in recent decades, present classifications of the genus *Russula* are based largely on such macroscopic features as spore colour, smell and taste, or the alteration of the colour of the context that have often not been noted for the African material. It is both possible and necessary — even for the better-known *Russula* floras from Europe or North America — to exploit the microscopic features more than is actually done for the delimitation of the various taxa, but good illustrations are a prerequisite for reliable comparison and correct interpretation of microscopic features. As macroscopic features are desirable for identification in the field, these have been used in the key below. Microscopic structures are illustrated for all the species to confirm field identifications.

### Importance of the Russulaceae in tropical Africa

Various authors (Hennings 1901, 1902, Patouillard 1914, 1927, Beeli 1928, 1936, Singer 1935, 1942, 1955, 1973, Heim 1938b, 1943, 1968, 1970, 1971, Perreau 1983, Buyck 1988, 1989b-d, 1990a, b) occasionally have described one or more tropical African *Russulae*, but apart from 2 major contributions — one on the Russulaceae of Madagascar (Heim 1938a) and a recent one on the genus *Russula* in Central Africa (Buyck 1989e, 1993b) — no other taxonomic studies on African Russulaceae have been made.

The Russulaceae are extremely common in most of the lowland rain forest and among the woodland vegetation of Africa. By number of described species, the Russulaceae are the most

important ectomycorrhizal partners of trees in the tropical lowlands of Africa. For the Guineo-Congolian domain, 65 *Russula* and 21 *Lactarius* species have been described. When taking also the surrounding woodlands of the Sudano-Zambezian domain into consideration, the total number of tropical African *Russula* species amounts presently to 129 (Buyck 1992), outnumbering by far the 31 and 12 *Russulae* described from the lowland neotropics (Singer et al. 1983) and the Lesser Antilles (Pegler 1983) respectively. Recent inventories in the rain forest of Cameroon (Watling, pers. comm.) and the woodlands of Zambia, Burundi and Malawi still reveal many undescribed species (Buyck, unpubl.).

For East Africa only three native *Russulae* were known (Pegler 1977, Morris 1990). Both these publications as well as some of the earlier contributions on Central African Russulaceae (Beeli 1928, Heim 1938a) cite several Russulaceae that have originally been described from Europe.

### Tanzanian species of *Russula*

The only published records of *Russula* for Tanzania are those in "The preliminary agaric flora for East Africa" (Pegler 1977). Among these, *R. emetica* (Schaeff.) Pers.: Fr., *R. fragilis* (Fr.) Fr. and *R. atropurpurea* (Krombh.) Britzelm. are not accepted here because they almost certainly are based on misidentifications. *R. deremensis* Hennings, described from the Usambara Mts, Tanzania, and *R. cinerella* Pat., described from Madagascar, present problems, because the type material is either lost (*R. deremensis*) or in too poor a condition to study (*R. cinerella*), and correct interpretation is difficult without a modern description. We can doubt the presence of *R. cinerella* in Tanzania because the illustration by Heim (1938a: fig. 42) of the spore ornamentation of the type is quite different from the ornamentation of the specimen described from Tanzania by Pegler under this name. Buyck has seen the specimen described by Pegler in the Kew Herbarium, and the exsiccatum matches *R. subfistulosa* Buyck exactly.

The systematic arrangement of the collected species (Table 1) is according to Buyck (1992). Several subsections are placed only provisionally in a section, especially in section *Heterophyllae*, because examination of fresh material is needed to complete the description with regard to the

nature of pigmentation or organoleptic features. At subsectional level, however, the groups are probably very homogeneous and natural.

All Tanzanian *Russula* species are discussed below in alphabetical order. We did not study the collections described by Pegler (1977). Indication of likely hosts for the various *Russula* species is based on observations of the position of the carpophores and result usually from the second author's personal experience.

Indication of spore size (only for the new species) includes 20 measurements excluding ornamentation. Maximum and minimum measurements are given in brackets, mean size is underlined and accompanied by standard deviation; relation length/width of the spores is added (Q), in the form of mean value with standard deviation. Macroscopic notes are those of the collectors, microscopic descriptions are based on observations made of samples stained with Congo Red, usually after a brief KOH-solution treatment.

### Key to the known species of *Russula* in Tanzania

(Features included are from the Tanzanian specimens.)

1. Occurring in pine plantations, pileus up to 70 mm in diam, greyish brown with rusty spots, strongly striate near margin, lamellae cream; stipe white, turning greyish at base, taste mild ..... *R. pectinatoides*
1. Occurring in natural vegetation ..... (2)
  2. Annulate species, remnants of the partial veil might eventually remain attached to the pileus margin ..... (3)
  2. Without annulus ..... (5)
3. Taste acrid after some time, pileus up to 40 mm in diam, ochraceous, bruising brown; lamellae white, with lamellulae; stipe white, tapering towards the base ..... *R. acriannulata*
3. Taste mild, pileus more than 40 mm in diam ..... (4)
  4. Pileus 50–60 mm in diam, greyish violet, lamellae cream, in woodland ..... *R. hiemisilvae*
  4. Pileus up to 55 mm in diam, violet–brown, lamellae white with a lilac tint near the edge, in moist montane forest ..... *R. annulata*
5. Lamellulae abundant ..... (6)
5. Lamellulae absent or rare ..... (9)
  6. Lamellae and/or lamellulae not remarkably crowded, taste mild; flesh bruising reddish or brown with age or when cut, with distinct smell; pileus 90–110 mm in diam ..... (8)
  6. Lamellae and lamellulae densely crowded, taste acrid; flesh bruising or not but never strongly so, pileus usually smaller ..... (7)
7. Pileus brown or yellowish brown, >50 mm in diam., lamellae white with brown edge ..... *R. subfistulosa*

7. Pileus cream, <40 mm in diam, lamellae yellowish with concolorous edge ..... *R. tanzaniae*  
 8. Spores ellipsoid, distinctly cristate-subreticulate ..... *R. phaeocephala*  
 8. Spores ellipsoid, almost smooth, very faintly and densely cristate-reticulate ..... *R. heimii*  
 9. Lamellae frequently and distinctly forked ..... (10)  
 9. Lamellae never or only exceptionally forked ... (11)  
 10. Firm species with yellow to greyish yellow pileus, 30–60 mm in diam, fissuring towards the margin and with a characteristic brownish tomentum near the base of the stipe; pellis peelable, resembling an epithelium; flesh chambered in stipe, without special odor, mild; lamellae thin, crowded, white ..... *R. cellulata*
10. Pileus 85–90 mm in diam, light yellow–brown to grey, with incurved margin; pellis peeling half-way, sticky when moist; stipe almost white; flesh without special odour, mild; lamellae close, thin and narrow, whitish with pinkish tone .....  
 ..... *R. liberiensis*  
 11. Colour of the pileus at least partially reddish, violaceous or pinkish ..... (12)  
 11. Colour of the pileus without any reddish, violaceous or pinkish tint ..... (16)  
 12. Stipe distinctly reddish all over; pileus small (<50 mm in diam), taste mild ..... (13)  
 12. Stipe basically whitish, eventually greyish, brownish or yellowish with age or on bruising; pileus usually larger ..... (14)

Table 1. Systematical arrangement of the Tanzanian *Russula* species

Section	Subsection	Species
<i>Compactae</i> Fries	<i>Nigricantes</i> Bataille	<i>R. phaeocephala</i>
	<i>Ingentinae</i> Buyck	<i>R. heimii</i>
<i>Plorantes</i> Bataille ex Singer	<i>Archaeinae</i> (Heim ex Romagn.) Buyck	<i>R. tanzaniae</i> sp. nov.
<i>Fistulosae</i> Buyck	<i>Fistulosinae</i> Heim ex Singer	<i>R. subfistulosa</i> <i>R. cinerella</i> sensu Pegler 1977
	<i>Testaceoaurantiacinae</i> Buyck	<i>R. cf. tuberculosa</i> (fide Pegler 1977)
	<i>Pectinatinae</i> Bon	<i>R. pectinatoides</i>
<i>Ingratae</i> Quélet	<i>Foetentinae</i> Melzer & Zvara	<i>R. deremensis</i>
	<i>Brunneodermatinae</i> Buyck	<i>R. cellulata</i> <i>R. liberiensis</i> <i>R. tenuithrix</i> sp. nov.
<i>Heterophyllae</i> Fries	<i>Guayarenses</i> Singer	<i>R. usambarae</i> sp. nov.
	<i>Ilicinae</i> (Romagn.) Buyck	<i>R. albofloccosa</i>
	<i>Heterophyllinae</i> (Maire) Schaeffer	<i>R. annulata</i> s.l. <i>R. hiemisilvae</i> sp. nov. <i>R. sublaevis</i> stat. nov.
	<i>Paradermatinae</i> Buyck	<i>R. acuminata</i>
<i>Crassotunicatae</i> (Singer) Singer	<i>Amoeninae</i> Singer ex Buyck	<i>R. ciliata</i>
	<i>Echinospematinae</i> Buyck	<i>R. echinosperma</i>
	<i>Aureotactinae</i> Heim ex Buyck	<i>R. acriannulata</i> sp. nov.
<i>Polychromae</i> Maire	<i>Luteomaculatinae</i> Buyck	<i>R. compressa</i> <i>R. sesenagula</i>
	incertae sedis	<i>R. testacea</i>
<i>Constantes</i> Singer	<i>Sardoninae</i> Singer	<i>R. congoana</i>

13. Lamellae yellowish . . . *R. congoana* var. *congoana*  
 13. Lamellae whitish with pinkish tint .. *R. acuminata*  
 14. Lamellae white; pileus 65 mm in diam, dull red; pellis half-way peeling *R. echinosperma*  
 14. Lamellae yellowish at maturity ..... (15)  
 15. Fragile species of moist forest; taste slightly peppery; pileus ca. 30 mm in diam, unevenly dark red, slightly pruinose, with pellis entirely separable and detached at margin; stipe yellowing with a very faint reddish tone ..... *R. sesenagula*  
 15. Fragile woodland species; taste mild, usually no particular smell; pileus 25–70 mm in diam, bright red, shiny, with pellis entirely separable; stipe white, sometimes bruising slightly brownish at base .. ..... *R. compressa*  
 16. Lamellae white or pale cream ..... (17)  
 16. Lamellae with an ochre tint; pileus 60–70 mm in diam, light brown, darker at the center, dull, finely cracked pellis, striate towards the margin; stipe usually shorter than the pileus diam, base concolorous, becoming paler towards the top; taste mild; smell weakly sour ..... *R. testacea*  
 17. Pileus cream or bright yellow–green ..... (18)  
 17. Pileus with dominant greyish or brownish tints (20)  
 18. Pileus cream-coloured, with distinct appressed pellicules, 55–70 mm in diam, mild, without smell ..... *R. albofloccosa*  
 18. Pileus more distinctly coloured, smooth or pruinose ..... (19)  
 19. Fruit bodies small; pileus 20–40 mm in diam, dull, olive golden to yellow or bright yellow–green; stipe tapering downwards, faintly yellowish, especially after handling ..... *R. ciliata*  
 19. Fruit bodies medium-sized; pileus bright yellow, 30–60 mm in diam; stipe subcylindrical, white ... ..... *R. sublaevis*  
 20. Pileus greenish grey with grey stipe; spores with low but distinct warts, locally confluent, forming small ridges [if almost smooth spores with minute isolated warts: *R. cinerella*] ..... *R. tenuithrix*  
 20. Pileus brown to orange brown or even bright orange ..... (21)  
 21. Bright orange pileus and stipe, at least in mature specimens ..... *R. aff. tuberculosa*  
 21. Pileus brown to orange–brown ..... (22)  
 22. Taste acrid and distinct disagreeable smell; gill edge concolorous with sides of lamellae ..... *R. deremensis*  
 22. Taste faintly acrid after a while; without smell; gill edge distinctly brown ..... *R. usambarae*

1. **Russula acriannulata** Buyck, sp. nov. — Figs. 5, 17, 26, 29

*Pileus* usque ad 40 mm latus, ochraceus, in centro saturate brunneus; margine fortiter striatus. *Lamellae* albae, usque ad 3 mm latae, lamellulis intermixtae. *Stipes* annulatus, basim versus attenuatus, albus. *Caro* initio mitis, dein

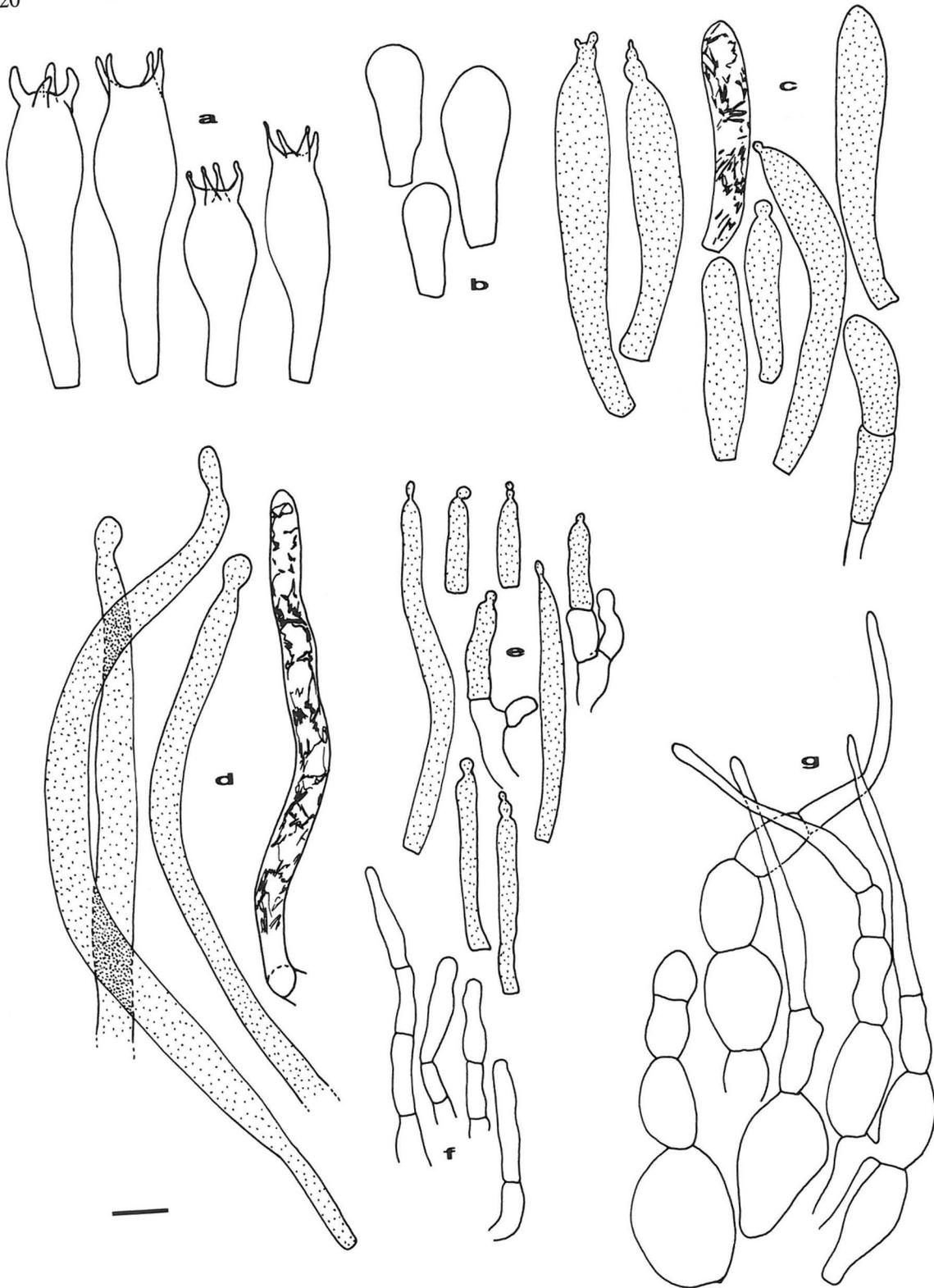
nimio acris, inodora. *Sporae* in cumulo colore ignotae.

*Sporae* subglobosae, (8.4–)8.76–9.14–9.53(–9.9) x (7.4–)7.78–8.11–8.43(–8.7)  $\mu\text{m}$  (Q = (1.08–)1.13(–1.17)), dense spinis distinctis moderate acutis isolatis usque ad 2  $\mu\text{m}$  altis generaliter fortiter amyloideis verrucis valde parvioribus intermixtis ornatae; macula suprahilare indistincta, verrucis parvis ornata. *Basidia* voluminosa, 35–55 x 12–16  $\mu\text{m}$ , tetraspora; sterigmata fortia. *Cystidia* abundantia in acie lateribusque, 35–65 x 6–10  $\mu\text{m}$  in acie, longiora in lateribus, emergentia, clavata, capitulata, contentu distincta SV+ repleta, tenuitunicata. Trama lamellarum spherocystis endocyst idiisque cylindratis efformata. *Pileipellis* angusta; subpellis paulum trama differentiat, hyphis tenuibus leviter incrustatis cystidiisque longissimis numerosis 6–9  $\mu\text{m}$  latis, obtusis vel capitatis, contentu distincta repletis composita; suprapellis hyphis tenuibus 3–5  $\mu\text{m}$  diam. subcylindratis gracilibus dense septatis plus minusve in trichoderma agregatis pileocystidiisque numerosis anguste cylindratis, 15–85 x 3–5  $\mu\text{m}$ , capitulatis contentu distincta repletis composita. *Stipitipellis* hyphis cystidiisque numerosis pileipelli comparandibus efformata.

*Holotypus*: Tanzania. Tanga Prov.: Lushoto Distr., W Usambara Mts, Mazumbai, N of the Mazumbai Forest Reserve border, N of the Kambi Falls (04 38 DC), lower montane forest, 1 680 m, 8.XII.1989 Harkönen 10112 (H).

*Pileus* up to 40 mm in diam, ochre, darker brownish in the center; margin strongly striate. *Lamellae* white, up to 3 mm broad, with lamellulae. *Stipe* annulate, white, tapering towards the base. *Flesh* very thin, at first mild, at last almost acrid, no particular smell. *Spore print* not obtained (probably pale).

*Spores* subglobose to broadly ellipsoid, (8.4–)8.76–9.14–9.53(–9.9) x (7.4–)7.78–8.11–8.43(–8.7)  $\mu\text{m}$  (Q = (1.08–)1.13(–1.17)), densely ornamented with very prominent, rather blunt, isolated verrucae, measuring up to 2  $\mu\text{m}$  high, usually strongly amyloid, mixed with smaller verrucae; suprahilar spot indistinct, occupied by small, weakly amyloid verrucae, becoming larger towards the margin. *Basidia* voluminous, 35–55 x 12–16  $\mu\text{m}$ , often rather short, bearing usually 4 stout sterigmata. *Cystidia* abundant, especially near the sterile gill edge, there 35–65 x 6–10  $\mu\text{m}$  and often staining brown, on the sides of the gills longer (but difficult to measure because of fragility), hardly emerging, clavate,



capitulate, well differentiated by abundant SV+ contents, thin-walled. *Trama* of the gills composed entirely of spherocytes, but with long, cylindrical endocystidia; subhymenium also cellular. *Pileipellis* very thin; subpellis hardly differentiated from the underlying trama, hyphae with thin but weakly encrusted walls, intermixed with very numerous and prominent dermatocystidia, these up to several hundreds of  $\mu\text{m}$  long, 6–9  $\mu\text{m}$  in diam, broadly rounded to capitate, with distinct contents; suprapellis a loose trichoderm composed of very fragile and thin-walled elements, short-celled, more or less cylindrical, 3–5  $\mu\text{m}$  thick; dermatocystidia in suprapellis very abundant, narrowly cylindrical, sometimes very short, 15–85  $\times$  3–5  $\mu\text{m}$ , capitulate, with distinct contents, thin-walled. *Stipitipellis* very similar, caulocystidia equally abundant.

*Vernacular names.* Unknown.

*Edibility.* Unknown.

*Ecology.* Humid lower montane forest.

*Likely hosts.* Unknown.

*Material examined:* **Tanzania.** Tanga Prov.: holotype; same data, *Saarimäki* 421.

*Observations.* This is a very puzzling species, showing affinities with subsection *Concolorinae* Buyck (*Fistulosae*) by the subglobose, strongly ornamented spores, by the coloured hymenial elements near the gill edge, and by the form of the basidia, cystidia and the elements of the pileipellis, but differing principally by the possession of abundant dermatocystidia in suprapellis and in the underlying tissue continuing even into the lamellar trama. Similar presence of abundant cystidial elements in the whole of the carpophore was also described (Buyck 1993b) for several species in subsection *Aureotactinae* Heim ex. Buyck.

*Aureotactinae* is an exclusively African subsection and was transferred to section *Crassotunicatae* (Singer) Singer (Buyck 1992). It comprises both annulate (*R. xylophila* Beeli, *R. brunneoannulata* Buyck, *R. radicans* Heim) and non-annulate (*R. aureotacta* Heim) species usually characterized by a strongly yellowing context. *R. oleifera* Buyck, placed previously in

*Aureotactinae*, should be transferred to section *Ingratae* Quélet, subsection *Foetentinae* Melzer and Zvára.

## 2. *Russula acuminata* Buyck, Bull. Jard. Bot. Nat. Belg. 58:467 (1988) — Fig. 6

*Description.* Buyck 1993b.

*Vernacular names.* Unknown.

*Edibility.* Unknown.

*Ecology.* Humid equatorial or lower montane forest.

*Likely hosts.* Unknown.

*Material examined:* **Tanzania.** Tanga Prov.: Lushoto Distr., W Usambara Mts, Mazumbai, N of the Mazumbai Forest Reserve border, and Kambi Falls, Kwamshundi (04 38 DC), lower montane forest, 1 710–1 800 m, 8.XII.1989 *Saarimäki* 426. **Zaire.** Buyck (1993b).

*Observations.* As macroscopic observations are very limited (see key), the identification is based on microscopic features. However, both are in good agreement with the type description (Buyck 1993b). Minor differences concern mainly the ornamentation of the spores which is less crested but as well developed as in the type, and the larger diameter of the pileocystidia.

## 3. *Russula albofloccosa* Buyck, Bull. Jard. Bot. Nat. Belg. 60:199 (1990) — Fig. 7

*Description.* Buyck (1993b).

*Vernacular names.* Manifuma (Sukuma).

*Edibility.* Inedible (Nyamwezi, Sukuma).

*Likely hosts.* Burundi. *Brachystegia microphylla* (Buyck, unpubl.). Zambia. *Uapaca kirkiana*, *Brachystegia spiciformis*, *Baphia bequeartii*, *Isobertinia angolensis*, *Julbernardia paniculata*, *Albizia adianthifolia*, *Uapaca nitida* (Buyck, unpubl.).

*Material examined:* **Tanzania.** Western Prov.: Kahama Distr., 45 km SW of Kahama, Mpunze, Forest Reserve (03 32 CD), on soil in woodland, 1 150 m, 10.XII.1991 *Saarimäki et al.* 1041. Tabora Distr., 10 km S of Tabora, Kipalapala (05 32 BB), on soil in miombo woodland, 1 200 m, 12.XII.1991 *Saarimäki et al.* 1067; 40 km S of Tabora, between Tabora and Urambo (05 32 AB),

Fig. 5a–g. — a–f. *Russula acriannulata* (type), g. *R. ciliata* (1022). — a: basidia, b: basidiola, c: hymenial cystidia, d: dermatocystidia of subpellis of pileus center, e: dermatocystidia of suprapellis of pileus center, f, g: hyphal extremities of pileus center. Bar = 10  $\mu\text{m}$ .

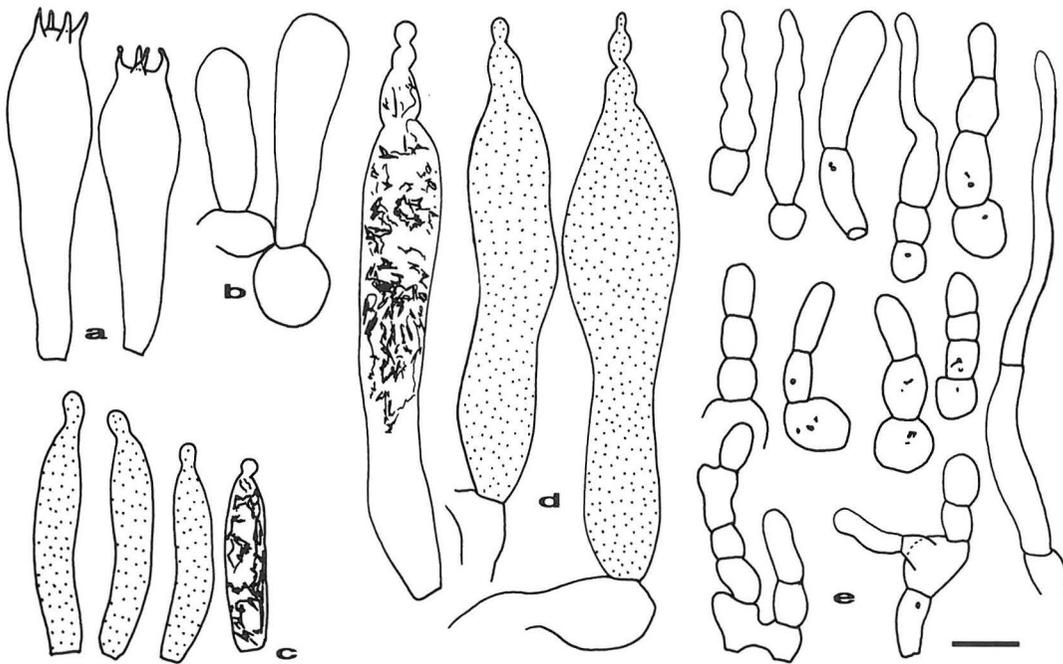


Fig. 6a–e. *Russula acuminata* (426). — a: basidia, b: basidiola, c: dermatocystidia of suprapellis of pileus center, d: hymenial cystidia, e: hyphal extremities of pileus center. Bar = 10  $\mu$ m.

in miombo woodland, 1 100 m, 13.XII.1991 *Saarimäki et al.* 1078. **Zaire, Burundi.** Buyck (1993b). **Zambia.** Buyck (unpubl.).

**Observations.** A typical species of miombo woodland, probably occurring all over the Zambesian domain, often in large numbers. It is easily recognized by the pale yellowish and later cream-coloured to almost white pileus covered with appressed, usually paler pellicules. There is no specific smell, and the taste is mild for all 3 Tanzanian specimens, but has been noted to become faintly acrid after a while in collections from Zaire (Buyck 1993b).

The microscopic features are very similar in specimens from all countries (see also discussion under *R. sublaevis*). Typical features include the low number of lamellar cystidia with a faintly positive sulfovanilline reaction and a very fragile wall; the suprapellis, which is fragmented into appressed pellicules, contains subulate, mucronate pileocystidia and has a virescens-structure, but long cylindrical pileocystidia are present in the subpellis and in the underlying trama.

#### 4. *Russula annulata* Heim, *Candollea* 7:392 (1938) — Figs. 8, 17

**Description.** Buyck (1993b), Heim (1938a).

**Vernacular names.** Unknown.

**Edibility.** Unknown.

**Ecology.** Humid equatorial or lower montane forest.

**Likely hosts.** Unknown, possibly *Gilbertiodendron dewevrei* in Zaire.

**Material examined:** **Tanzania.** Tanga Prov.: Lushoto Distr., W Usambara Mts, Mazumbai, N of the Mazumbai Forest Reserve border, and Kambi Falls, Kwamshundi (04 38 DC), lower montane forest, 1 710–1 800 m, 8.XII.1989 *Härkönen* 10113. **Zaire.** Buyck (1993b).

**Observations.** In Africa this is probably the most cited and misunderstood name for *Russula*. Heim (1938a, b) described many varieties and forms for this species, some of them having been given species status by Buyck (1988, 1990a, b). References in the literature may mean almost any annulate *Russula*. The loss of the type material makes it very difficult to define this species exactly. *R. annulata* has also been reported by Pegler (1977) from the East Usambara Mountains.

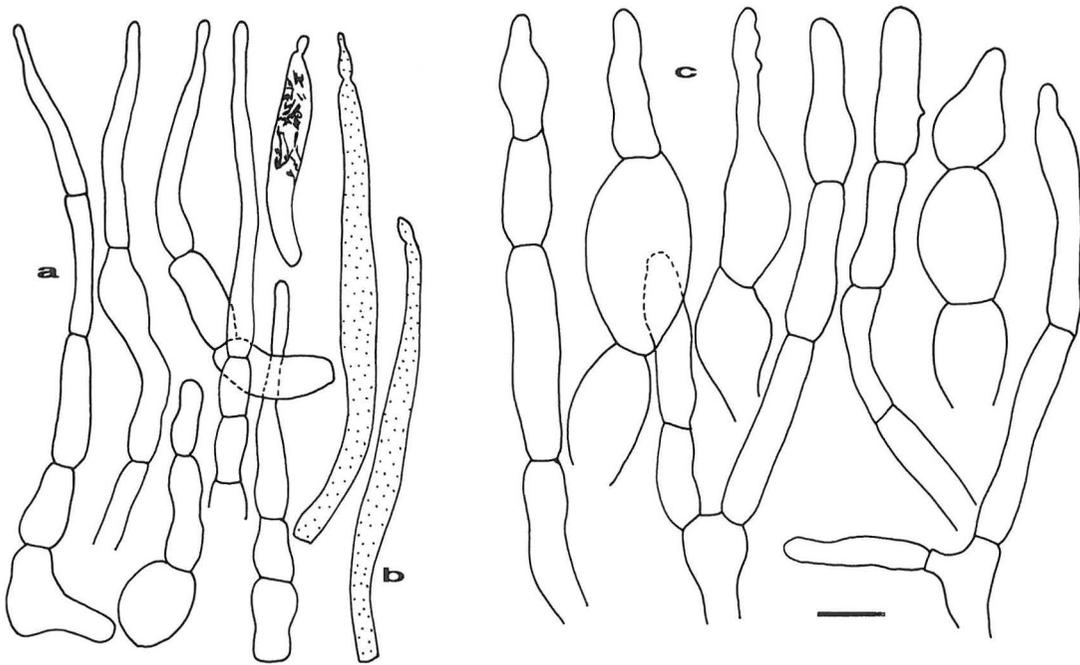


Fig. 7a-c. — a, b. *Russula albofloccosa* (1078), c. *R. echinosperma* (913). — a: hyphal extremities of pileus suprapellis, b: dermatocystidia of pileus suprapellis, c: hyphal extremities of pileus suprapellis. Bar = 10  $\mu$ m.

**5. *Russula cellulata*** Buyck, Bull. Jard. Bot. Nat. Belg. 59:245 (1989) — Figs. 9, 35

*Description.* Buyck (1993b).

*Vernacular names.* Utyelele (Nyamwezi).

*Edibility.* Edible (Nyamwezi).

*Ecology.* Woodland.

*Likely hosts.* Burundi. *Brachystegia microphylla* (Buyck, unpubl.). Tanzania. Probably *Brachystegia*.

*Material examined:* **Tanzania.** Western Prov.: Tabora Distr., 20 km W of Tabora, Lulanguru (05 32 BA), on soil in woodland with *Brachystegia*, *Terminalia*, *Combretum*, *Dichrostachys*, *Annona*, *Vitex*, *Markhamia*, 1 100 m, 14.XII.1991 Saarimäki et al. 1105a. **Zaire, Burundi.** Buyck (1993b). **Zambia, Malawi.** Buyck (unpubl.).

*Observations.* A firm and common woodland species probably with a Zambesian distribution, occurring singly or in scattered groups. It is recognized in the field by the yellowish to greyish brown pileus disrupting radially but characteristically also in a concentric mode from the margin towards the center. Another specific character is the ferruginous pileipellis-like covering of the stipe base which typically breaks up in horizontal bands or polygonal scales. The

latter feature was very prominently present in the Tanzanian collection, but can be absent or indistinct as in the type collection (see Buyck 1993b). Several specimens collected in Burundi showed a very pronounced greying context. There is no particular taste or smell. The most typical feature is the cellular aspect of the pileus, which forms a very dense layer in the pileus centre and becomes gradually less dense and composed of larger cells towards the margin. Brown pigmented hyphal extremities are emerging locally from the cellular layer. The pileipellis and the very partially reticulated spores showing an inamyloid suprahilar spot (plage) are the most reliable features in distinguishing *R. cellulata* from similar species. Most collections have scattered and very small, slightly emergent, capitulate dermatocystidia, which are best observed outside the very pileus center as the clavate extremities of the center are much smaller and densely packed into a trichoderm to hymeniderm-structure.

*R. cellulata* is in the field easily confused with a number of other species which occur in the same habitat, often growing side by side with *R.*

*cellulata*. *R. immaculata* (Beeli) Dennis var. *mamillata* Buyck (subsect. *Mamillatinae* Buyck) shares a similar stipe base and a pronounced greying context, but has a yellowish-brown pileus and spores with an amyloid plage and completer reticulum, as well as large cylindrical, obtuse pileocystidia which do not protrude into the dense trichoderm but stay confined to the subpellis.

*R. liberiensis* Singer, which is discussed below, can also be confused with *R. cellulata*.

*R. schizoderma* Pat. (subsect. *Virescentinae* Singer) might also be similar, but its type (PC) was not found. Morris (1987) illustrated and discussed a marketed mushroom in Malawi which Pegler identified for him as *R. schizoderma*. The

aquarel represents almost certainly *R. cellulata*, but it is possible that more than one of the above-mentioned species are referred to by the same vernacular name.

6. *Russula ciliata* Buyck, Bull. Jard. Bot. Nat. Belg. 57:387 (1987) — Figs. 5, 20

*Description*. Buyck (1993b).

*Vernacular names*. Utyelele (Nyamwezi), Bunitelele (Sumbwa).

*Edibility*. Edible (Nyamwezi, Sumbwa).

*Ecology*. Woodland.

*Likely hosts*. Burundi. *Brachystegia microphylla* (Buyck, unpubl.). Zambia. *Julbernardia paniculata*, *Brachystegia allenii*, *Brachystegia*

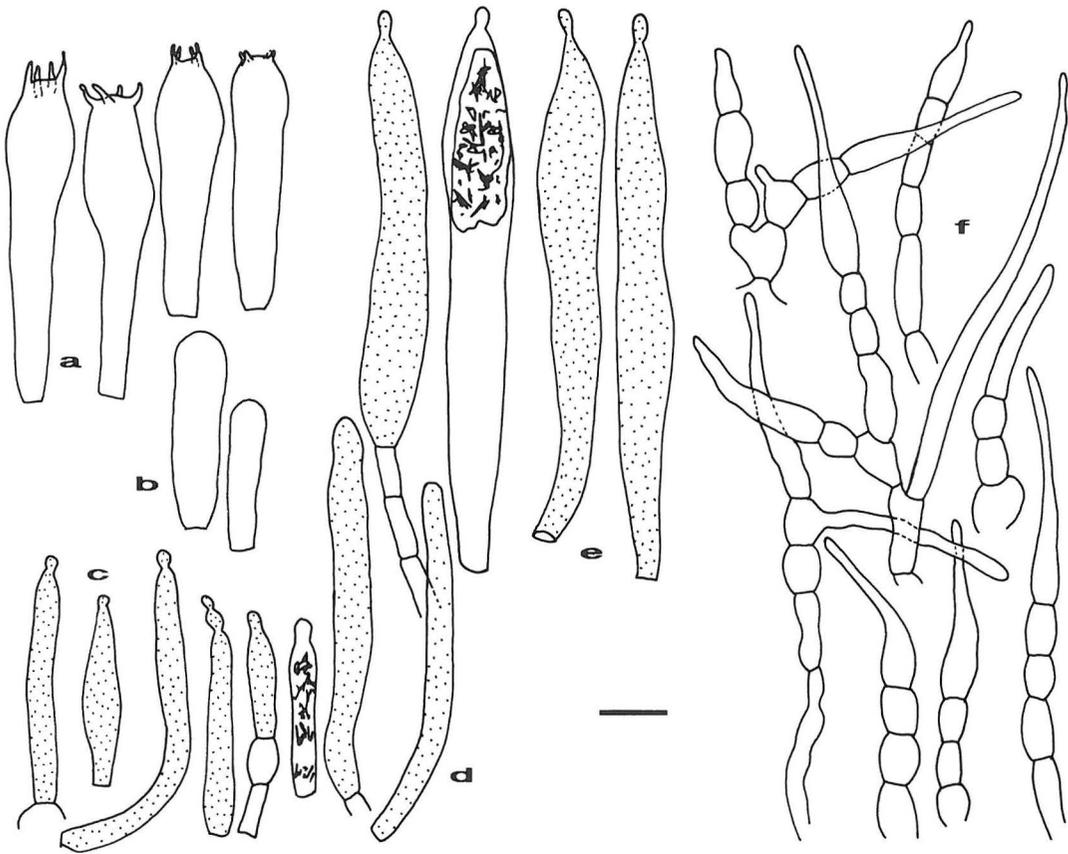


Fig. 8a–f. *Russula annulata* s.l. (10113). — a: basidia, b: basidiola, c: dermatocystidia of suprapellis of pileus center, d: dermatocystidia of subpellis of pileus center, e: hymenial cystidia, f: hyphal extremities of pileus suprapellis. Bar = 10  $\mu$ m.

*boehmii*, *Pericopsis angolensis*, *Pseudolachnostylis maprouneifolia* (Buyck, unpubl.).

**Material examined:** **Tanzania.** Western Prov.: Kahama Distr., 30 km W of Kahama, Wendele, Forest Reserve (03 32 CB), on soil in *Brachystegia-Combretum* woodland, 1 200 m, 9.XII.1991 *Saarimäki et al.* 1022. Tabora Distr., 20 km W of Tabora, Lulanguru (05 32 BA), degraded woodland, 1 110 m, 14.XII.1991 *Saarimäki et al.* 1119. **Zaire.** Buyck (1993b). **Burundi, Zambia,** probably also **Malawi.** Buyck (unpubl.).

**Observations.** A very distinct, small and common woodland species probably occurring all over the Zambesian domain, often in large numbers. It is easily recognized by the typical yellow to green colour of the pileus, although collections from Zambia and Burundi (Buyck, unpubl.) sometimes show an orange to wine-red pileus colour, especially towards the margin. When the pileus is dry, the granular-floccose to scurfy covering of the pileus is very prominent, but when moist is hidden by a thick slimy layer.

7. ***Russula compressa*** Buyck, Bull. Jard. Bot. Nat. Belg. 59:252 (1989) — Fig. 10

**Description.** Buyck (1993b).

**Vernacular names.** Bufutwamvula, Busege-se, Dumu ya mzee, Katundu, Mnyitundu (Nyamwezi), Utundule (Safwa), Butundutundu (Sukuma), Nitundu (Sumbwa).

**Edibility.** Edible (Nyamwezi, Safwa, Sukuma, Sumbwa), inedible (Bena).

**Ecology.** Woodland.

**Likely hosts.** Burundi. *Brachystegia bussei*, *B. utilis*, *B. microphylla* (Buyck, unpubl.). Tanzania. *Brachystegia* or *Julbernardia*.

**Material examined:** **Tanzania.** Southern Highlands Prov.: Mbeya Distr., a few km E of Mbeya, Ipembe Hill (08 33 CD), on soil in degraded miombo woodland with *Uapaca*, *Brachystegia* and *Parinari*, 1 760 m, 28.III.1991 *Saarimäki et al.* 751. Lake Prov.: Mwanza Distr., Buharahara, a few km W of Geita (02 32 CD), on soil in miombo woodland with *Brachystegia*, *Julbernardia*, *Combretum*, *Albizia*, 1 250 m, 5.XII.1991 *Saarimäki et al.* 1012. Western Prov.: Kahama Distr., 30 km W of Kahama, Wendele, Forest Reserve, on soil in *Brachystegia-Combretum* woodland, 1 200 m, 9.XII.1991 *Saarimäki et al.* 1024; 45 km SW of Kahama, Mpunze, Forest Reserve, on soil in woodland, 1 150 m, 10.XII.1991 *Saarimäki et al.* 1038. Tabora Distr., 10 km S of Tabora, Kipalapala (05 32 BB), on soil in miombo woodland, 1 200 m, 12.XII.1991 *Saarimäki et al.* 1066, 1068; 20 km W of Tabora, Lulanguru (05 32 BA), in degraded woodland, 1 100 m, 14.XII.1991 *Saarimäki et al.* 1120. **Burundi, Zaire.** Buyck (1993b). **Zambia.** Buyck (unpubl.).

**Observations.** A very common red-capped *Russula* with yellowing context usually occurring in scattered groups all over the Zambesian miombo area. *Saarimäki et al.* 1066 was the only collection resembling the type in its fishy smell.

*R. compressa* differs in the field from the many other red-capped *Russulae* either by its larger size, yellowing (not greying) context or by the absence of red colour in the stipe. *R. compressa* was characterized (Buyck 1993b) by the low, irregular and broadly obtuse spore ornaments opposing it to the very similar but apparently rare *R. sejuncta* Buyck, which has sharp, conical and  $\pm$  regular ornaments (Buyck 1993b). The microscopic features of pileipellis are also rather variable (see Fig. 10): unicellular clavate to multicellular and subcylindrical pileocystidia, many to almost no extremities surpassing the general level of the trichoderm and these extremities composed of either short or of long cells.

8. ***Russula congoana*** Patouillard, Bull. Soc. Mycol. France 30:336 (1914) — Figs. 10, 19

**Descriptions.** Buyck (1993b), Pegler (1977).

**Vernacular names.** Butundutundu (Sukuma), Katundu, Mnyitundu (Nyamwezi).

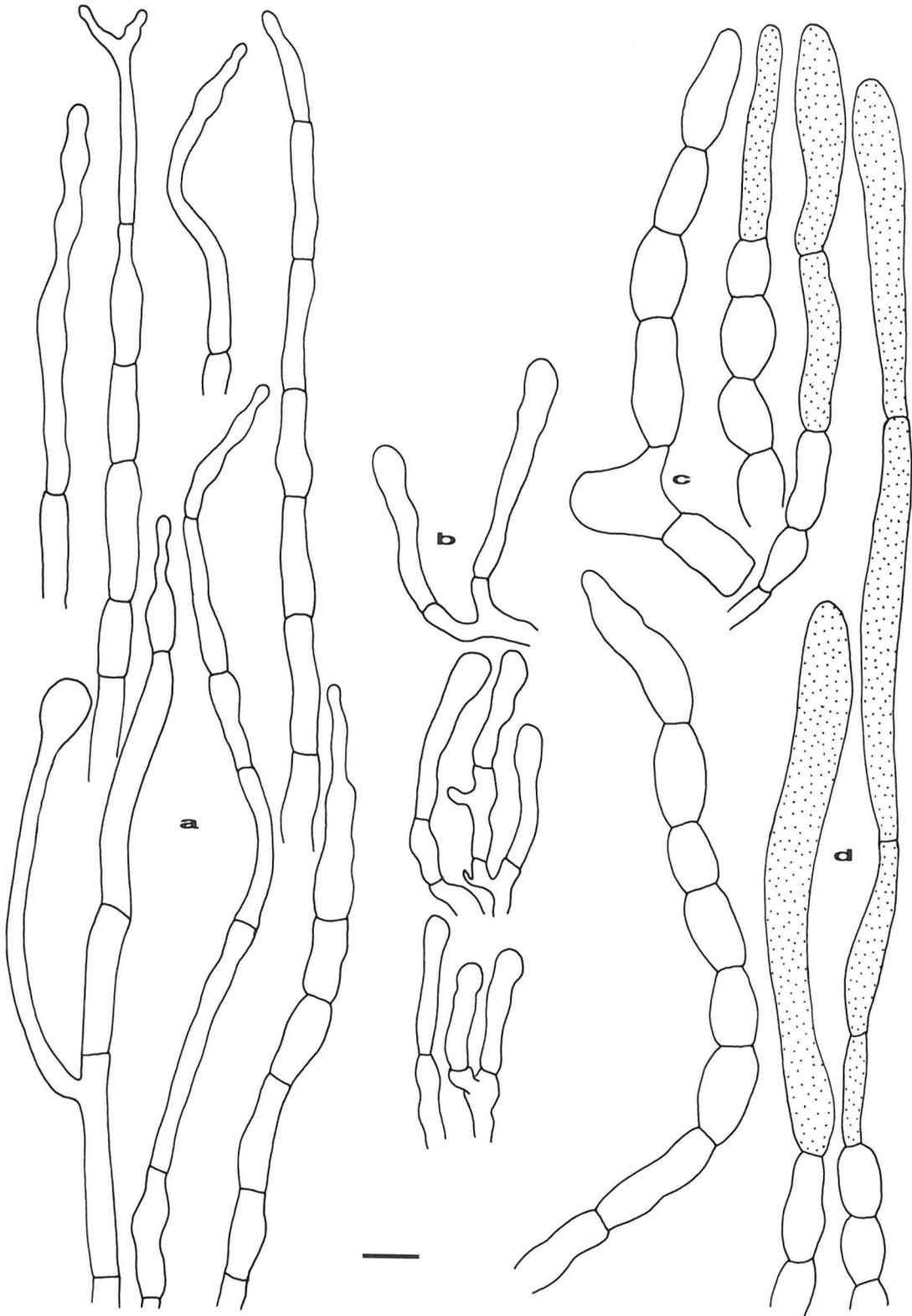
**Edibility.** Edible (Nyamwezi, Sukuma).

**Ecology.** Woodland.

**Likely hosts.** Burundi. *Brachystegia microphylla*, *B. bussei*, *B. spiciformis*. Zambia. *Marquesia macrourea*, *Brachystegia boehmii*, *B. spiciformis* (Buyck, unpubl.).

**Material examined:** **Tanzania.** Lake Prov.: Mwanza Distr., Buharahara, a few km W of Geita (02 32 CD), on soil in miombo woodland with *Brachystegia*, *Julbernardia*, *Combretum*, *Albizia*, 1 250 m, 5.XII.1991 *Saarimäki et al.* 1011, 1013. Western Prov.: Kahama Distr., 45 km SW of Kahama, Mpunze, Forest Reserve (03 32 CD), on soil in woodland, 1 150 m, 10.XII.1991 *Saarimäki et al.* 1040. **Burundi, Congo, Zaire.** Buyck (1993b). **Zambia.** Buyck (unpubl.).

**Observations.** A common, widespread and small woodland species, which is easily recognized because of the red colour of both stipe and pileus. It was also reported from Tanzania by Pegler (1977). It is very close to *R. bururiensis* Buyck, which differs mainly by its larger size and by the smaller and less ornamented spores (see Buyck 1993b).



9. *Russula echinosperma* Heim & Gilles apud Heim, Rev. Mycol. 36:130 (1971) — Figs. 7, 18

*Descriptions.* Buyck (1993b), Heim (1971).

*Vernacular names.* Unknown.

*Edibility.* Unknown.

*Ecology.* Woodland.

*Likely hosts.* Unknown.

*Material examined:* **Tanzania.** Tanga Prov.: Lushoto Distr., W Usambara Mts, Mazumbai (04 38 DC), in the surroundings of the village, lower montane forest, 1 400–1 500 m, 18.IV.1991 Saarimäki et al. 913. **Gabon, Zaïre.** Buyck (1993b).

*Observations.* This is only the fifth collection for this species, which was first described from Gabon and is apparently a typical rain forest species. The second author (BB) has never found it in miombo collections from Zaïre, Zambia, Burundi or Malawi. The type (PC) is lost, but the identification is based on comparison with a specimen which was also collected by Gilles in Gabon and labelled by Heim as *R. echinosperma* (see Buyck 1992).

The three species presently placed in subsection *Echinospermatinae* are easily recognized under the microscope by the voluminous extremities of the hyphae and the isolated, acute ornaments of the spores which lack an amyloid plage, and the absence of dermatocystidia. The composition of the pileipellis is reminiscent of subsection *Olivaceinae* Singer sensu Romagnesi (1967), from which subsection *Echinospermatinae* differs mainly by the pale spore deposit (probably white) and the absence of the typical phenol reaction. *R. echinosperma* is separated from both other *Echinospermatinae* by the overall reddish-violet colour of the pileus, the very long spines on the spores and, from *R. acriuscula*, also by the mild taste.

Although placed provisionally in section *Heterophyllae* Fr. (Buyck 1993b), this subsection might be better placed in section *Crassotunicatae*.

10. *Russula heimii* Singer, Ann. Mycol. 40:73 (1942) — Figs. 11, 23

*R. velutipes* Heim, Candollea 7:387 (1938) non Velenovsky (1920).

*Descriptions.* Buyck (1993b), Heim (1938a).

*Vernacular names.* Shimbwoga (Safwa).

*Edibility.* Edible (Safwa), inedible (Bena).

*Ecology.* Woodland.

*Likely hosts.* *Brachystegia* or *Uapaca*.

*Material examined:* **Tanzania.** Southern Highlands Prov.: Mbeya Distr., a few km E of Mbeya, Ipembe Hill, on soil in degraded miombo woodland with *Uapaca*, *Brachystegia* and *Parinari*, 1 600 m, 28.III.1991 Saari-mäki et al. 745. **Madagascar.** Heim (1938a).

*Observations.* This is the second find for this species, originally described from Madagascar, and known only from the type (PC, Heim F76). The Tanzanian specimen matches the type very well, both macroscopically (orange-brown pileus centre, paler towards the margin, cream lamellae, white stipe with profuse white mycelium, pinkish turning flesh with distinct odour and slowly acrid taste) and microscopically. A modern description was provided by Buyck (1989e, 1992: fig. 213). A typical microscopic feature appears to be the very long, slender nature of all elements: basidia (53–)60–75 × 7–10 µm, cystidia up to 150 µm long but only 6–8 µm in diam, elements of the pileipellis only 3–5 µm in diam. The cystidial elements hardly react with sulfovanilline.

11. *Russula hiemisilvae* Buyck, sp. nov. — Figs. 12, 21

*Pileus* fragilis, 50–60 mm latus, planus-convexus; margine involutus, fortiter striatus; pellis cinereo-violacea, secernens. *Lamellae* adnatae, cremeae, confertae, usque ad 4 mm latae, angustae; acies concolora, integra. *Stipes* 50–55 × 10 mm, subcylindratus, attenuatus in basi extrema, albus vel leviter violaceo tinctus,

Fig. 9a–d.— a. *Russula liberiensis* (755), b. *R. cellulata* (1105a), c, d. *R. sesenagula* (408). — a–c: hyphal extremities of pileus suprapellis, d: dermatocystidia of pileus suprapellis. Bar 10 = µm.

glabrus, cavus in vetere; annulo libri angusto praeditus. *Caro* alba, inodora, mitis. *Sporae* in cumulo colore ignotae.

*Sporae* ellipsoideae, (8.4–)8.84–9.18–9.51(–9.7) × (7.2–)7.42–7.72–8.03(–8.4) μm (Q = (1.13–)1.19(–1.27)), moderate dense reticulatae, ornamentis conicis obtusis in cristis angustis confluentibus vel distincte interconnectis valde amyloideis usque ad 1.5 μm altis ornatae; macula suprahilaris distincta sed inamyloidea. *Basidia* 54–66 × 12–14 μm, pedicellato-clavata, tetraspora. *Cystidia* dispersa, 65–80 × 10–14 μm, paulum emergentia, clavata vel fusiformia, generaliter appendiculato-capitata, tenuitunicata; contentu distincta, in SV rufescente repleta. *Cellulae marginales* basidioliformes, clavatae ad fusiformes, obtusae, parvae. *Pileipellis* orthochromatica in azureo cresylico; subpellis hyphis tenuibus gelatinosis efformata; suprapellis extremitatibus brevibus dense septatis ramosis, ex cellula basale inflata ac cellula terminale generaliter sursum attenuata ac 1–2 cellulis plus minusve ellipsoideis interpositis compositis efformata; pileocystidia 20–35(–45) × 5–6(–8) μm, terminalia, fusiformia vel lageniformia, capitulata. *Stipitipellis* minus gelatinosa.

*Holotypus*: **Tanzania**. Western Prov.: Kahama Distr., 30 km W of Kahama, Wendele, Forest Reserve (03 32 CB), on soil in *Brachystegia-Combretum* woodland, 1 200 m, 9.XII.1991 Saarimäki et al. 1028 (H).

*Pileus* 50–60 mm in diam, convex to flat, at first involuted; margin broadly striate; pellis greyish violet, distinctly peeling. *Lamellae* adnexed, cream, crowded, up to 4 mm broad, fairly thin; edge smooth, concolorous. *Stipe* 50–55 × 10 mm, equal, tapering at base, white or with a faint violet tone, smooth, becoming hollow with age. *Ring* narrow, free around the stipe. *Flesh* white, without smell; taste mild. *Spore print* not obtained.

*Spores* ellipsoid, (8.4–)8.84–9.18–9.51(–9.7) × (7.2–)7.42–7.72–8.03(–8.4) μm (Q = (1.13–)1.19(–1.27)), rather densely ornamented with conical, obtuse elements which are up to 1.5 μm high, strongly amyloid, distinctly interconnected or

united into narrow ridges, completely re-ticulate; suprahilar spot distinct but not amyloid. *Basidia* 54–66 × 12–14 μm, clavate to pedicellate, 4-spored. *Cystidia* dispersed, 65–80 × 10–14 μm, slightly emergent, clavate to fusiform, usually appendiculate or capitulate, thin-walled; contents distinct, with almost negative reaction (reddening) in sulfovanillin. *Marginal cells* clavate to fusoid, basidiole-like, obtuse, distinctly smaller than the basidia. *Pileipellis* orthochromatic in cresyl blue, a gelatinized subpellis composed of slender hyphae, 2–4 μm in diam; suprapellis composed of short and densely septate extremities formed of one or two ellipsoid cells carrying a longer tapering terminal cell and supported by a larger branching cell at the base; terminal cell slightly restricted below the apex and more or less capitate; pileocystidia 20–35(–45) × 5–6(–8) μm, terminal, fusoid to lageniform, capitulate. *Stipitipellis* more or less similar to the pileipellis but less gelatinized.

*Vernacular names*. Nitundu (Sumbwa).

*Edibility*. Edible (Sumbwa).

*Ecology*. Woodland.

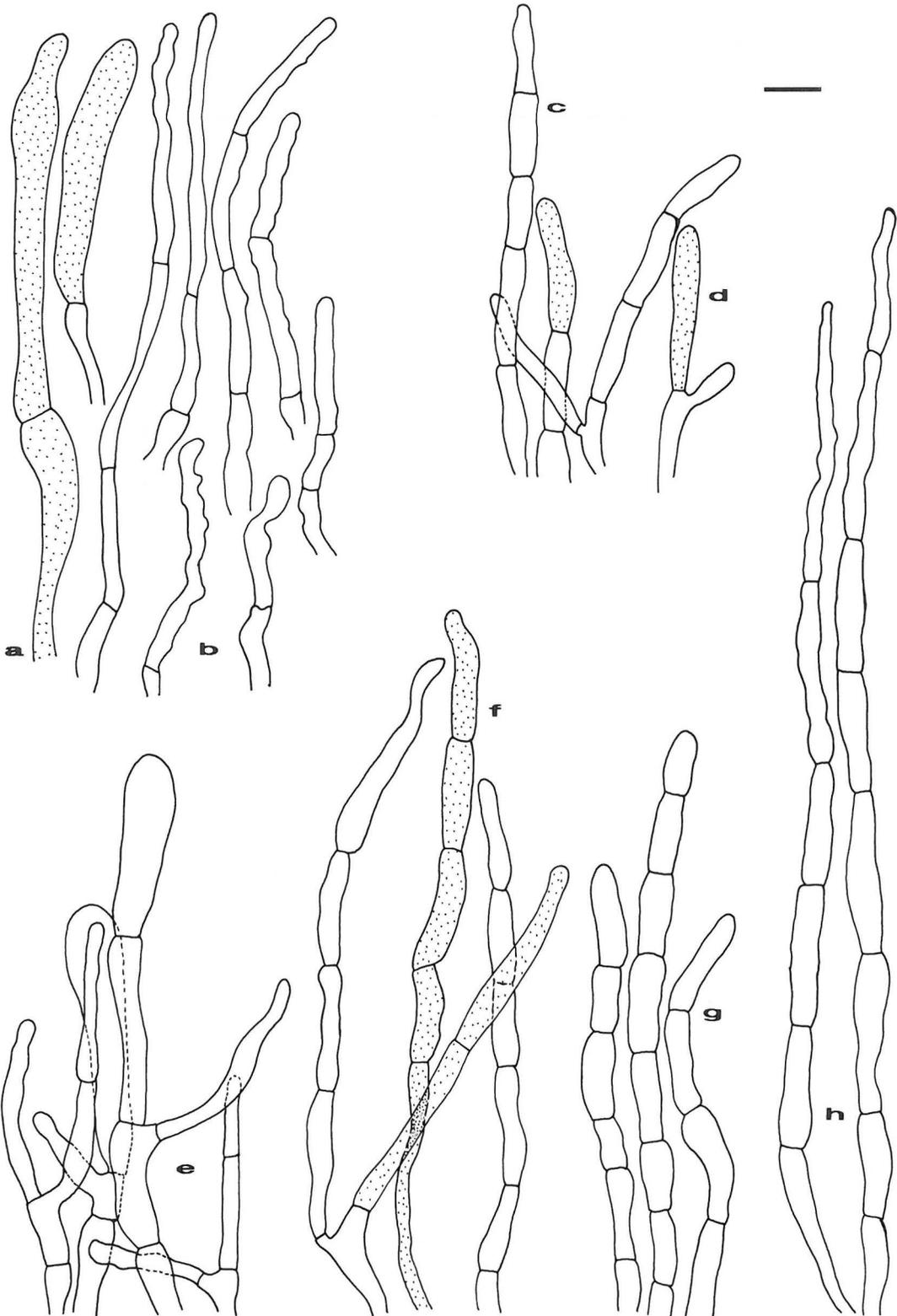
*Likely hosts*. Burundi. *Brachystegia microphylla* (Buyck, unpubl.). Tanzania. Probably *Brachystegia*.

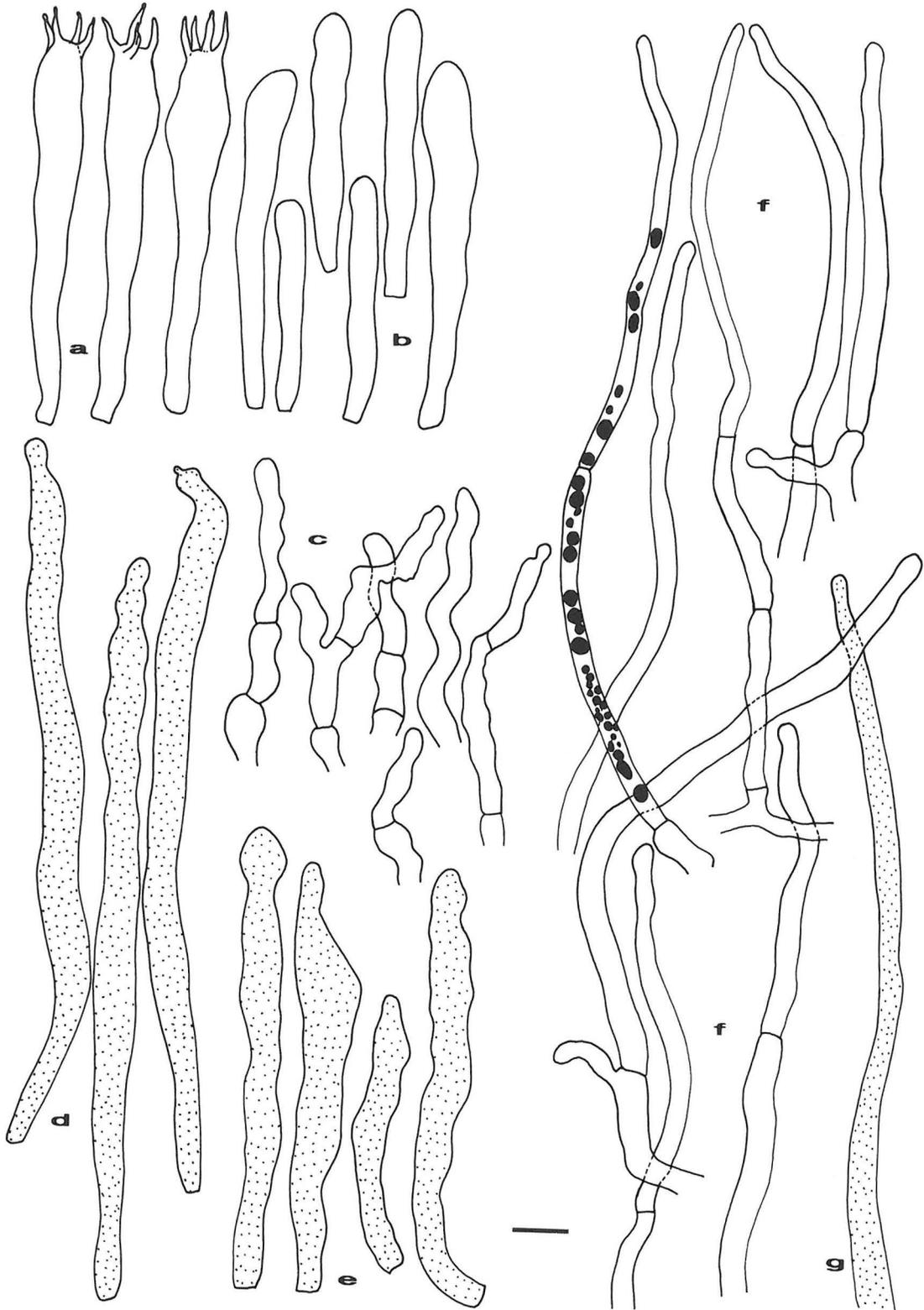
*Material examined*: **Tanzania**. Western Prov.: holotype. **Burundi**, **Zambia**. Buyck (unpubl.). Perhaps **Senegal**, **Zaire**. Buyck (1993b).

*Observations*. A common annulate species in miombo vegetation, usually gregarious with two or three fruit bodies. It is well characterized by its large dimensions, typical pileus colour and ellipsoid spores (most other annulate species have nearly globose spores with more pronounced ornamentation).

Very similar collections have been described from Shaba in Zaire, and were attributed (Buyck 1993b) to *R. rosealba* Buyck sensu lato. These differ mainly from the Tanzanian collection in the slightly different spore ornamentation which shows more individualised verrucae. It might be a subspecies of *R. hiemisilvae*.

Fig. 10a–h. — a, b. *Russula congoana* (1011), c–h. *R. compressa* c, d: 1038, e: 1066, f: 1068, g: 1120, h: 1012. Elements of pileus suprapellis: dermatocystidia with schematic indication of contents, ordinary hyphal extremities represented as empty. Bar 10 = μm.





12. *Russula liberiensis* Singer, Pap. Michigan Acad. Sci. 32:112 (1946) — Figs. 9, 23

*Description.* Buyck (1993b).

*Vernacular names.* Shimbwoga? (Safwa).

*Edibility.* Edible (Bena, Safwa), inedible (Nyamwezi).

*Ecology.* Woodland.

*Likely hosts.* Burundi. *Brachystegia microphylla* (Buyck, unpubl.). Tanzania. Probably *Uapaca* or *Brachystegia*.

*Material examined:* **Tanzania.** Southern Highlands Prov.: Mbeya Distr., a few km E of Mbeya, Ipembe Hill (08 33 CD), on soil in degraded miombo with *Uapaca*, *Brachystegia* and *Parinari*, 1 760 m, 28.III.1991 Saari-mäki et al. 755. Western Prov.: Tabora Distr., 20 km W of Tabora, Lulanguru (05 32 BA), degraded woodland, 1 100 m, 14.XII.1991 Saari-mäki et al. 1118. **Liberia.** Buyck (1993b). **Burundi, Zambia, Zaïre.** Buyck (unpubl.).

*Observations.* A rare woodland species resembling *R. cellulata* by the colour of the pileus and the forked lamellae. It differs from the latter in the composition of the pileipellis, which is not epitheloid and has a smooth to finely areolate aspect, and in the larger variation of the spore ornamentation.

Saarimäki et al. 1118 is a somewhat aberrant collection because of the extremely tortuous, irregular form of the hyphal extremities in the suprapellis and the abundance of oleiferous hyphae. The spores, however, fit the description as well as fitting most of the macroscopic observations that have been made.

13. *Russula pectinatoides* Peck, Rep. New York State Bot.: 90, pl. 105, figs. 6–10 (1906)

*Description.* Romagnesi (1967).

*Vernacular names.* Unknown.

*Edibility.* Unknown.

*Likely hosts.* Accompanying introduced *Pinus* in Africa.

*Material examined:* **Tanzania.** Northern Prov.: Arusha Distr., Mt Meru W slope, NE of Olmotonyi, close to Laikinoi, Training Forest of the Sokoine Univ. of Agriculture (03 36 BC), *Pinus patula* plantation, 1 950 m, 15.XII.1989 Saari-mäki 478, 480.

*Observations.* An introduced *Russula*, which is restricted to *Pinus* plantations in Africa.

14. *Russula phaeocephala* Buyck, Bull. Jard. Bot. Nat. Belg. 59:246 (1989) — Figs. 13, 22

*Description.* Buyck (1993b).

*Vernacular names.* Mashikoba, Usihwe (Nyamwezi).

*Edibility.* Some consider edible, some inedible (Nyamwezi).

*Ecology.* Woodland.

*Likely hosts.* Tanzania. Probably *Brachystegia* or *Julbernardia*.

*Material examined:* **Tanzania.** Lake Prov.: Mwanza Distr., Buharahara, a few km W of Geita (02 32 CD), on soil in miombo woodland with *Brachystegia*, *Julbernardia*, *Combretum* and *Albizia*, 1 250 m, 5.XII.1991 Saari-mäki et al. 1007a. **Burundi.** Buyck (1993b).

*Observations.* This is only the second record for this species. It agrees almost completely with the type in its macro- and microscopic features and its woodland habitat (the type was found in degraded woodland vegetation). The Tanzanian collection of *R. phaeocephala* has a distinct smell which resembles the smell of *Lactarius rufus*.

The capitulate pileocystidia are very rare and easily overlooked because of their poor contents and small dimensions.

Other species of subsection *Nigricantes* with mild taste and similar spore ornamentation are *R. areolata* Buyck, which occurs also in woodland vegetation but has much more widely spaced and also thicker lamellae and a different aspect of the pileus (cf. Buyck 1993b: pl. 58/1), and *R. afronigricans* Buyck (cf. Buyck 1993b: pl. 59/1), which has smaller spores and was found in equatorial rain forest in Zaïre.

15. *Russula sesenagula* Beeli, Bull. Soc. Roy. Bot. Belg. 60:166 (1928) — Fig. 9

*Description.* Buyck (1993b).

*Vernacular names.* Unknown.

*Edibility.* Unknown.

*Ecology.* Humid equatorial to lower montane forest.

*Likely hosts.* Zaïre. Probably *Gilbertiodendron dewevrei* (Buyck 1989).

*Material examined:* **Tanzania.** Tanga Prov.: Lushoto Distr., W Usambara Mts, Mazumbai Forest Reserve border

Fig. 11a–g. *Russula heimii* (745). — a: basidia, b: basidiola, c: marginal cells of lamella edge, d: pleurocystidia, e: cheilocystidia, f: hyphal extremities of pileus suprapellis with indication of brown necropigment in one element, g: dermatocystidium of pileus suprapellis. Bar = 10 µm.

(04 38 DC), in moist lower montane forest, 1 600 m, 7.XII.1989 *Saarimäki 408*. **Burundi, Zambia**. For *R. sesenagula* s.l. (Buyck, unpubl.). **Zaire**. Buyck (1993b).

*Observations*. This species was conceived sensu lato (Buyck 1993b) because apparently a large number of  $\pm$  reddish tropical *Russula* species have more or less the same composition of the pileipellis and spore ornamentation. The Tanzanian collection agrees in every respect with *R. sesenagula* sensu stricto, having almost identical microscopic and macroscopic (see key) features as the type (see Buyck 1993b), the whitish lamellae of the type forming the only notable exception; but this might be due to immaturity.

*R. sesenagula* sensu stricto differs from the other species of subsection *Luteomaculatinae* by the fact that the suprapellis is composed solely of large elements comparable to those that surpass the general level of the suprapellis in the other

species (e.g. *R. compressa*). The small and narrow extremities composing the major part of the trichoderm in the other *Luteomaculatinae* are not present in *R. sesenagula* sensu stricto.

16. ***Russula subfistulosa*** Buyck, Bull. Jard. Bot. Nat. Belg. 60:193 (1990) — Figs. 14, 36, 37

*Description*. Buyck (1993b).

*Vernacular names*. Unknown.

*Edibility*. Unknown.

*Ecology*. Humid forest to woodland.

*Likely hosts*. Burundi. *Brachystegia spiciformis*, *B. bussei*, *B. utilis*, *B. microphylla* (Buyck, unpubl.).

*Material examined*: **Tanzania**. Tanga Prov.: Lushoto Distr., W Usambara Mts, Mazumbai, N of the Mazumbai Forest Reserve border and Kambi Falls, Kwamshundi, in lower montane forest, 1 710–1 800 m, 8.XII.1989 *Härkönen 10121*. **Burundi, Zaire**. Buyck (1993b). **Zambia**. Buyck (unpubl.).

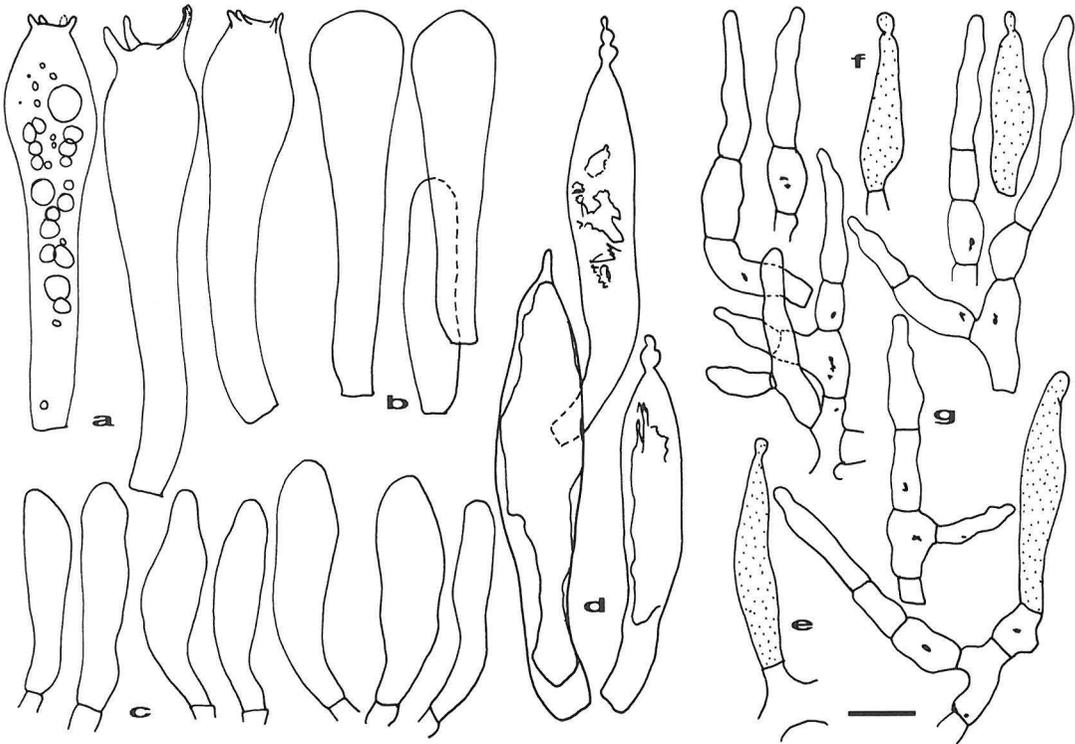


Fig. 12a–g. *Russula hiemisilvae* (type). — a: basidia, b: basidiola, c: marginal cells of lamella edge, d: hymenial cystidia, e, f: dermatocystidia of pileus suprapellis, g: hyphal extremities of pileus suprapellis. Bar = 10  $\mu$ m.

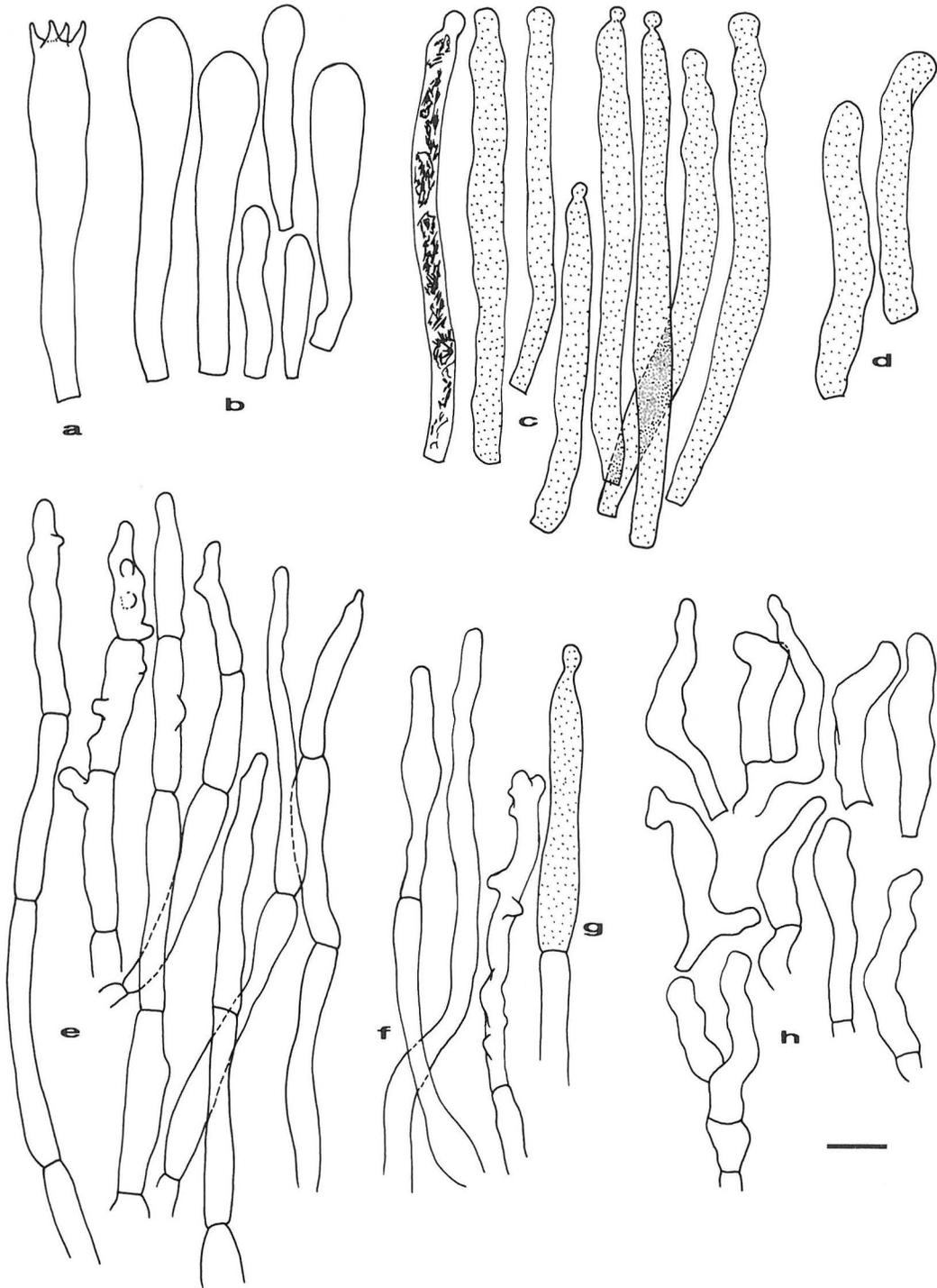


Fig. 13a–h. *Russula phaeocephala* (1007a). — a: basidia, b: basidiola, c: pleurocystidia, d: cheilocystidia, e, f: hyphal extremities of pileus center, g: dermatocystidia of pileus suprapellis, h: marginal cells of lamella edge. Bar = 10  $\mu$ m.

*Observations.* *R. subfistulosa* often occurs in large groups, both in the rain forest and in the woodland area. Different varieties have been recognized - most of them provisionally (Buyck 1993b). Var. *apsila*, known only from the type, was distinguished (Buyck 1990) on the basis of the denser ornamentation of the spores, the darker colour of the basidioma and the different ecology. This specimen agrees in the two latter features but has the spores of the var. *subfistulosa*. Clearly, study of additional collections is needed to define the value of the different varieties.

*R. subfistulosa* is characterized by the hot taste, the very crowded and narrow lamellae and lamellulae and the identical covering on stipe and pileus. In the field it is sometimes mistaken for some Tricholomataceae.

17. **Russula sublaevis** (Buyck) Buyck, stat. nov. — Figs. 15, 25, 33

Basionym: *R. roseoviolacea* Buyck forma *sublaevis* Buyck, Bull. Jard. Bot. Nat. Belg. 60:204 (1990).

*Description.* Buyck (1993b).

*Vernacular names.* Utyelele (Nyamwezi).

*Edibility.* Edible (Nyamwezi).

*Ecology.* Woodland.

*Likely hosts.* Tanzania. Probably *Brachystegia*.

*Material examined:* **Tanzania.** Western Prov.: Tabora Distr., 20 km W of Tabora, Lulanguru (05 32 BA), on soil in woodland with *Brachystegia*, *Terminalia*, *Combretum*, *Dichrostachys*, *Annona*, *Vitex*, *Markhamia*, 1 100 m, 14.XII.1991 *Saarimäki et al.* 1105b. **Zaire.** Buyck (1993b): holotype described from Lubumbashi region. **Malawi.** Buyck (unpubl.).

*Observations.* Already described by Buyck from a single collection (with insufficient field notes) from Zaire as *R. roseoviolacea* s.l. forma *sublaevis* Buyck. This collection, as well as a similar specimen collected by B. Morris in Malawi (Morris, unpubl.), shows that it definitely deserves to be ranked as a species. Its most distinctive features are a moderately large, yellow pileus, white lamellae and stipe and absolutely mild and odourless flesh. *R. sublaevis* is perhaps intermediate between *R. roseoviolacea*

Buyck (see Buyck 1993b) and *R. albofloccosa* Buyck, which have quite similar microscopic features. *R. roseoviolacea* and *R. albofloccosa* have both a pileus with prominent pellicules. All three species have reticulately ornamented spores: not dense and with distinct ridges in *R. roseoviolacea*, moderately dense and with more individualised verrucae in *R. albofloccosa*, and very dense to dense ornamentation with very low verrucae in *R. sublaevis*.

18. **Russula tanzaniae** Buyck, sp. nov. — Figs. 15, 24, 31

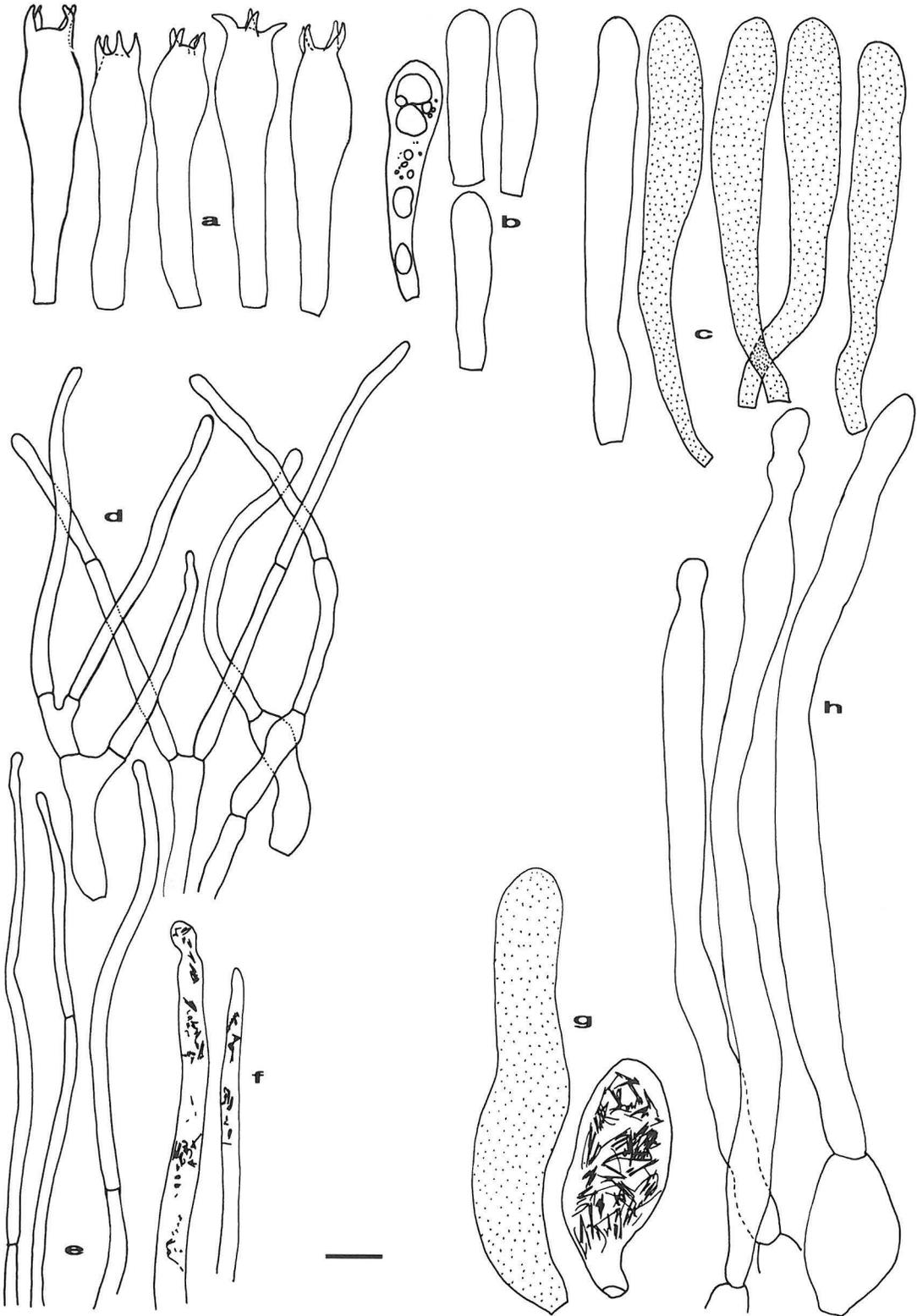
*Pileus* parvus, cremeus; pellis non secernens; margo non striatus. *Lamellae* colore flava tinctae, densissime dispositae (32 L/cm ad marginem). *Stipes* albus; sapor odorque acres. *Caro* acris. *Sporae* in cumulo colore ignotae.

*Sporae* breviter ellipsoideae, (5.9–)6.23–6.49–6.75(–6.9) × (5.0–)5.32–5.60–5.87(–6.1) μm (Q = (1.10–)1.16(–1.25)), verrucis parvis vel parvissimis obtusis sejunctis distincte amyloideis ornatae, macula suprahilaris inamyloidea, indistincta. *Basidia* 35–45 × 7–9 μm, tenuia, clavulata, tetraspora. *Cystidia* valde abundantia, vix emergentia, tenuia, 35–70(–100) × 6–8 μm, distinctiora in acie, subcylindrata ad clavata, obtusa vel minute capitata, contentu SV- abundante repleta. *Cellulae marginales* non differentiatiae. *Pileipellis* hyphis pileocystidiisque laxae intermixtis ambo subhorizontalibus irregularibus sinuosis, 2–6(–10) μm diam., saepe moderate crassotunicatis, orthochromaticis in azureo cresylico, laxae septatis efformata; cellula hypharum terminalis interdum moniliformis vel subapicale irregulariter inflata; pileocystidia contentu ac extremitate distincte capitata hyphis differentiatia. *Stipitipellis* hyphis plus minusve regularibus tenuitunicatis caulocystidiisque numerosis sursum inflatis composita.

*Holotypus:* **Tanzania.** Southern Highlands Prov.: Mbeya Distr., Mbozi (09 32 BB), miombo woodland planted with *Cupressus*, 1 650 m, 24.III.1991 *Saarimäki et al.* 708 (H).

*Pileus* small, cream-coloured; pellis not peeling at the margin. *Lamellae* yellowish, very crowded (32 lamellae + lamellulae/cm at pileus

Fig. 14a–h. — a–f. *Russula tenuithrix* (type), g–h. *R. subfistulosa* (10121). — a: basidia, b: basidiola, c: hymenial cystidia, d: hyphal extremities of pileus suprapellis, e: hyphal extremities of stipe, f: dermatocystidia of stipe suprapellis, g: dermatocystidia of pileus suprapellis, h: hyphal extremities of pileus suprapellis. Bar = 10 μm.



margin). *Stipe* white. *Flesh* brittle, with acrid taste and smell. *Spore deposit* not obtained.

*Spores* broadly ellipsoid, small, (5.9–)6.23–6.49–6.75(–6.9) × (5.0–)5.32–5.60–5.87(–6.1) μm (Q = (1.10–)1.16(–1.25)), with small to very small, obtuse, low but distinctly amyloid, isolated warts; suprahilar spot indistinct, not amyloid. *Basidia* 35–45 × 7–9 μm, not voluminous, slightly clavate, 4-sterigmate. *Cystidia* very abundant, hardly emergent, slender, 35–70(–100) × 6–8 μm, occupying almost the entire edge and there very obvious, subcylindric to clavate, broadly obtuse to minutely capitate; contents abundant but practically insensitive to SV. *Marginal cells* not particularly differentiated. *Pileipellis* a loosely interwoven mat of ± horizontal hyphae and pileocystidia, of very irregular diam, 2–6(–10) μm, tortuous and sinuose, with slightly thickened walls (usually 1 μm thick), entirely orthochromatic in cresyl blue, with dispersed septa; terminal cell often moniliform or irregularly inflated at the apex; pileocystidia irregularly cylindrical, of same dimensions as the hyphae, equally septate, usually capitate, with poor to abundant contents, also present in the trama (endocystidia). *Stipitipellis* showing the same general structure, but composed of more regular, almost cylindrical and more thin-walled elements; caulocystidia even more abundant, relatively large, broadly obtuse and slightly inflated near the apex.

*Vernacular names.* Unknown.

*Edibility.* Edible (Nyiha).

*Ecology.* Woodland.

*Likely hosts.* Unknown.

*Material examined:* **Tanzania.** Southern Highlands Prov.: holotype.

*Observations.* This is the third African species of subsection *Archaeinae*. It differs from both the others (see Buyck 1992) especially by the crowded lamellae. *R. auarum* Singer, placed by its author in a separate section (*Delicoarchaeae* Singer), resembles the present species in the irregularly tortuous hyphae of the pellis, but differs by its mild taste and crested spores. Sect. *Metachromaticae* Singer, based on metachromatic staining of the thick-walled cys-

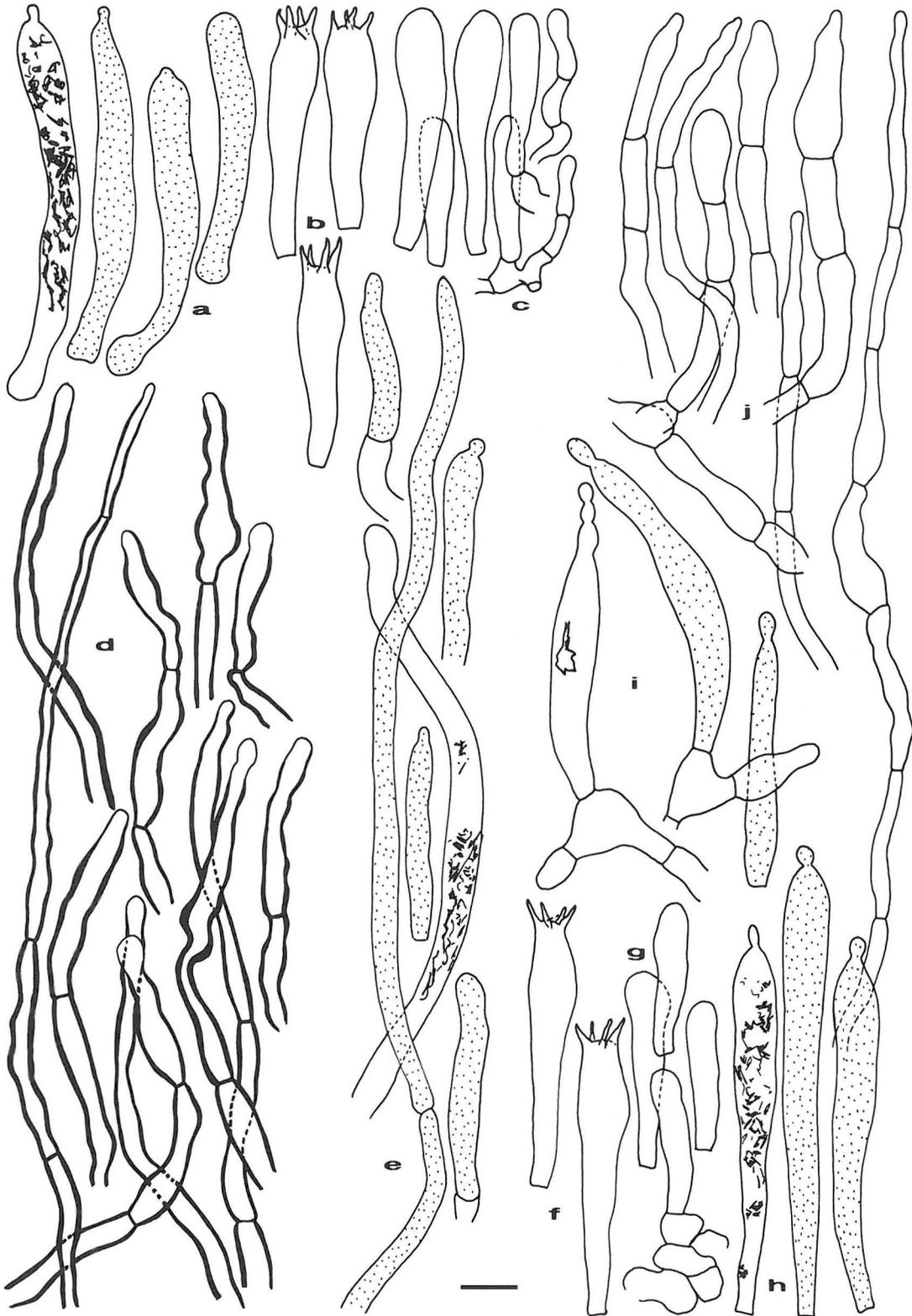
tidia but synonymized by Buyck (1990) with subsect. *Cyanoxanthinae* Singer because of a similar metachromatic reaction in cresyl blue and the equally elastic lamellae, also has rather closely related micro- and macroscopic features. A typical feature of subsection *Archaeinae* appears to be the very small spores ornamented with isolated, blunt and minute verrucae.

19. ***Russula tenuithrix*** Buyck, sp. nov. — Figs. 14, 27, 32, 34

*Pileus* 60 mm latus, irregulariter convexus, in centro depressus, pelle viridi-grisea, saturate grisea in centro, secernente praeditus, laevis. *Lamellae* adnatae, usque ad 10 mm latae, confertae, moderate crassae, flavo-albidae; acies integra, concolora. *Stipes* 50 × 15 mm, basim versus leviter attenuatus, saturate griseus. *Caro* alba, inodora, mitis. *Sporae in cumulo* colore ignotae.

*Sporae* ellipsoideae, (7.9–)8.07–8.49–8.91(–9.5) × (6.2–)6.39–6.70–7.01(–7.2) μm (Q = (1.19–)1.27(–1.34)), verrucis usque ad 0.5 μm altis convexis amyloideis dense dispositis plerumque subtile connectis, locale in cristis brevibus confluentibus ornatae, subreticulatae; macula suprahilare indistincta, verruculosa sed inamyloidea. *Basidia* (38–)40–50 × (9–)10–11 μm, tetraspora. *Cystidia* dispersa, vix emergentia, 50–70(–85) × 8–10(–12) μm, generaliter clavata vel subapicale attenuata, moderate tenuitunicata, contentu distincta sed paululum SV+ repleta. *Cellulae marginales* vix differentiatiae. *Pileipellis* orthochromatica in azureo cresylico; subpellis hyphis tenuibus, 3–4 μm diam., dermatocystidiisque filamentosis, 3–6 μm diam. efformata; suprapellis extremitates ramosae, locale fasciculatae, articulis cylindratis 2–3 μm diam., prope septis vel ramificationibus saepe usque ad 5 μm inflatis compositae, cellulis basalibus inflatis pigmento vacuolare brunneo praeditis plus minusve strato pseudo-parenchymatice agregatis ortae. *Stipitipellis* hyphis 2–3 μm diam. locale ad 5–7 μm inflatis caulocystidiisque cylindratis obtusis vel capitatis 4–8 μm diam. efformata.

Fig. 15a–j. — a–e. *Russula tanzaniae* (type), f–j. *R. sublaevis* stat. nov. (1105b). — a: hymenial cystidia, b: basidia, c: basidiola, d: hyphal extremities of pileus suprapellis, e: dermatocystidia of pileus suprapellis, f: basidia, g: basidiola, h: hymenial cystidia, i: dermatocystidia of pileus suprapellis, j: hyphal extremities of pileus suprapellis. Bar = 10 μm.



*Holotypus*: **Tanzania**. Western Prov.: Tabora Distr., 20 km W of Tabora, Lulanguru (05 32 BA), on soil in degraded woodland with *Agave sisalana*, *Brachystegia*, *Terminalia*, *Parinari*, *Albizia*, 1 100 m, 14.XII.1991 Saari-mäki et al. 1110 (H).

*Pileus* 60 mm in diam, asymmetrically convex, depressed at the center, greenish grey, darker at the center, smooth, peeling. *Lamellae* adnexed, up to 10 mm broad, closely arranged, moderately thick, yellowish white; edge smooth, concolorous. *Stipe* 50 x 15 mm, slightly narrowing at the base, dull grey. *Flesh* white, without special smell, mild. *Spore deposit* not obtained.

*Spores* ellipsoid, (7.9–)8.07–8.49–8.91(–9.5) x (6.2–)6.39–6.70–7.01(–7.2) µm (Q=(1.19–)1.27(–1.34)); ornamentation a dense and almost complete reticulum composed of very low (up to 0.5 µm), irregularly convex, delicately connected, amyloid elements, locally confluent in short and narrow ridges; suprahilar spot indistinct, slightly verruculose but not amyloid. *Basidia* (38–)40–50 x (9–)10–11 µm, 4-spored; sterigmata stout, 4–6 µm long. *Cystidia* dispersed, hardly emergent, 50–70(–85) x 8–10(–12) µm, mostly clavate, sometimes subapically slightly narrowed, with distinct, very weakly SV+ contents and slightly thickened wall. *Marginal cells* of lamella edge not particularly differentiated. *Pileipellis* orthochromatic in cresyl blue, composed of narrow hyphae which are 3–4 µm in diam in the subpellis, with dispersed long, slender, cylindrical dermatocystidia measuring 3–6 µm in diam and continuing in the underlying trama; suprapellis a trichoderm composed of ramified cylindrical extremities, locally fasciculated, 2–3 µm in diam but sometimes inflated to 5 µm at branching sites or near septa, slightly tapering at the top or broadly rounded to subcapitulate, usually containing a diffuse brown pigment, especially in the inflated branching cells; the latter forming a thin, more or less pseudoparenchymatous layer; dermatocystidia in the suprapellis not observed. *Stipitipellis* composed of hyphae 2–3 µm in diam, locally inflated to 5–7 µm, caulocystidia 4–6 µm in diam, cylindrical, obtuse to capitate.

*Vernacular names*. Unknown.

*Edibility*. Inedible (Nyamwezi).

*Ecology*. Woodland.

*Likely hosts*. Malawi, Tanzania. Probably *Brachystegia* (fide B. Morris for Malawi).

*Material examined*: **Tanzania**. Western Prov.: holotype. **Malawi**. Buyck (unpubl.).

*Observations*. This species is apparently closely related to *R. cinerella* Pat. (from Madagascar), which has much smoother spores and appendiculate, fusoid cystidia. Both have a greyish green pileus and the same dimensions for basidia and cystidia. Pegler described *R. cinerella* from Tanzania, but this collection had much more prominently warted spores.

20. ***Russula testacea*** Buyck, Bull. Jard. Bot. Nat. Belg. 58:475 (1988) — Fig. 16

*Description*. Buyck (1993b).

*Vernacular names*. Kansalaghe (Sukuma).

*Edibility*. Inedible (Sukuma).

*Ecology*. Woodland.

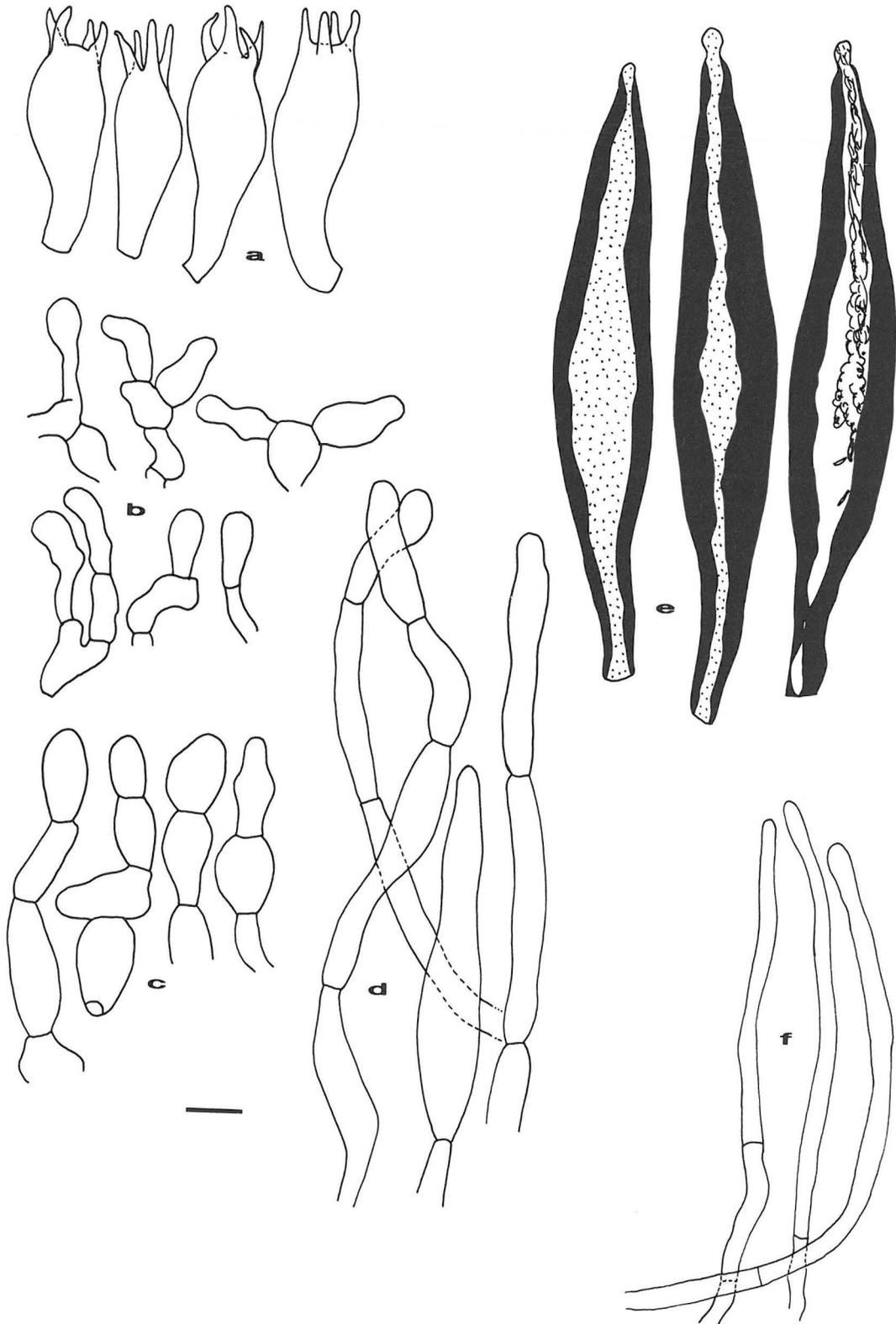
*Likely hosts*. Burundi. *Brachystegia microphylla*. Zambia. *Julbernardia paniculata*, *Brachystegia spiciformis* (Buyck, unpubl.).

*Material examined*: **Tanzania**. Western Prov.: Kahama Distr., 45 km SW of Kahama, Mpunze, Forest Reserve (03 32 CD), on soil in woodland, 1 150 m, 10.XII.1991 Saari-mäki et al. 1039, 1043. **Zambia**, **Burundi**. Buyck (unpubl.).

*Observations*. A widespread woodland species occurring singly or in small groups. It is easily recognized by the overall brownish ochraceous colour, the slightly paler lamellae being concolorous with the pileus margin and stipe apex. *R. testacea* is also microscopically well characterized by the features of the spores and composition of the trichodermal pileipellis which has none or not well-differentiated pileocystidia.

The systematic position of this species is doubtful. It could be placed either in sect. *Integrae* Maire or in sect. *Polychromae* Maire.

Fig. 16a–f. — a–e. *Russula usambarae* (type), f. *R. testacea* (1039). — a: basidia, b: hyphal extremities of pileus center, c: hyphal extremities of pileus margin, d: hyphal extremities of stipe, e: hymenial cystidia, f: hyphal extremities of pileus suprapellis. Bar = 10 µm.



21. *Russula usambarae* Buyck, sp. nov. — Figs. 16, 28, 30

*Pileus* 45 mm latus, brunneus, fortiter striatus ad marginem. *Lamellae* adnatae, usque ad 7 mm latae; acies brunnea. *Stipes* 50 x 15 mm, subcylindratus, brunneogriseus, cavus. *Caro* leviter acris, inodora, alba. *Sporae* in cumulo colore ignotae.

*Sporae* subglobosae ad breviter ellipsoideae, (9.2–)9.32–9.70–10.09(–10.9) x (8.1–)8.07–8.49–8.91(–9.5)  $\mu\text{m}$  (Q = (1.06–)1.12(–1.16)), elementis firmis 1.5(2)  $\mu\text{m}$  altis valde amyloideis generaliter acutoconicis dense dispositis interdum catenulatis vel raro connectis sursum rectis vel curvatis verrucibusque cylindratis obtusis parvioribus intermixtis ornatae; macula suprahilaris distincte amyloidea, verruculosa ad marginem, non decurrens. *Basidia* 30–45 x 11–14  $\mu\text{m}$ , voluminosa sed brevia, tetraspora. *Cystidia* 100–130(–180) x (12–)15–20(–23)  $\mu\text{m}$ , numerosa, conferta in acie, emergentia et valde distincta, fusiformia saepe capitulata, irregulariter sed valde crassotunicata, pariete in parte media 5–8(–10)  $\mu\text{m}$  lata extremitates versus attenuata praedita; sursum contentu SV-amorpho-granulosa praedita. *Pileipellis* orthochromatica in azureo cresyllico; pileocystidia non observata; subpellis paulum differentiatia; suprapellis extremitatibus irregulariter ramosis brevibus ex 2–3 cellulis ellipsoideis clavatis vel irregulariter inflatis 5–10  $\mu\text{m}$  latis pigmento brunneo repletis compositis efformata. *Stipitipellis* elementis longioribus subcylindratis efformata; cellula terminalis clavata vel apicem versus gradatim attenuata; caulocystidia non observata.

*Holopytus*: **Tanzania**. Tanga Prov.: Lushoto Distr., W Usambara Mts, Mazumbai, N of the Mazumbai Forest Reserve border and Kambi Falls, Kwamshundi, lower montane forest, 1 710–1 800 m, 8.XII.1989 *Saarimäki* 430 (H).

*Pileus* 45 mm in diam, brown, strongly striate towards the margin. *Lamellae* adnate, up to 7 mm broad, with a dark brown edge. *Stipe* 50 x 15 mm, subcylindrical, brownish grey, hollow. *Flesh* thin in the pileus, white; taste faintly sharp. *Spore deposit* not obtained.

*Spores* subglobose to broadly ellipsoid, (9.2–)9.32–9.70–10.09(–10.9) x (8.1–)8.07–8.49–8.91(–9.5)  $\mu\text{m}$  (Q = (1.06–)1.12(–1.16)), with firm, strongly amyloid, usually conical and acute ornaments, densely disposed, often grouped by two or three, often curved in the upper portion, very variable in

size, up to 1.5(2)  $\mu\text{m}$  high, mixed with cylindrical and more or less blunt to very small verrucae, some ornaments interconnected by rare and very subtle connections visible only at high magnifications; suprahilar spot distinctly greying in Melzer's Reagent, verruculose at the border, not decurrent on hilar appendix. *Basidia* 30–45 x 11–14  $\mu\text{m}$ , rather voluminous but short, bearing large prominent sterigmata, 4-spored. *Cystidia* 100–130(–180) x (12–)15–20(–23)  $\mu\text{m}$ , numerous, crowded at the edge, very prominent and emergent, fusoid, often capitulate, lamprocystidioid with irregularly thickened walls; wall reaching 5–8(–10)  $\mu\text{m}$  in the broadest part of the cystidium, narrowing toward the cystidium extremities; in upper part with granular amorphous SV-contents. *Pileipellis* composed of a badly individualised subpellis without cystidial elements; suprapellis composed of short, irregularly branched extremities of two or three ellipsoid, clavate to irregularly inflated elements, 5–10  $\mu\text{m}$  in diam, usually containing a brown diffuse pigment. *Stipitipellis* composed of longer, subcylindrical elements; the terminal cell either clavate or gradually tapering towards the apex; caulocystidia not observed.

*Vernacular names*. Unknown.

*Edibility*. Unknown.

*Ecology*. Humid lower montane forest.

*Likely hosts*. Unknown.

*Material examined*: **Tanzania**. Tanga Prov.: holotype.

*Observations*. The most prominent feature of this species is undoubtedly the possession of well differentiated lamprocystidia on both the edge and sides of lamellae — a unique feature in *Russula*. Only two species of *Russula* are known to possess lamprocystidia on the edge of the lamellae. They are placed in the exclusively tropical subsect. *Guayarenses* Singer (see Buyck 1993b), including two African species described from the Zaïrean rain forest. *R. usambarae* resembles *R. lamprocystidiata* Buyck, one of the two African members of subsect. *Guayarenses*, in the very dark brown, tomentose pileipellis, but differs in spore ornamentation and elements of the pileipellis.

Although the subsection *Guayarenses* is provisionally placed in section *Heterophyllae* it might be better put in section *Crassotunicatae* or section *Fistulosae*.

## Habitats of *Russula* in Tanzania

*Russula* specimens could be found in two kinds of habitats, that is in montane forests of Tanga Province and Northern Province and in miombo woodlands of Western Province, Lake Province and Southern Highlands Province.

### Montane forests

#### Tanga Province

Mazumbai Forest Reserve in the West Usambara Mts is situated at an elevation of 1 380–1 900 m with mean annual rainfall of ca. 1 230 mm. It is mainly montane rain forest on rugged rocky escarpment. Soils are humic, ferriferous.

There is great variation in vegetation with elevation. At lower elevations *Syzygium guineense*, *Isoblerlinia scheffleri*, *Parinari excelsa*, *Allanblackia stuhlmannii*, *Newtonia buchananii* and *Entandrophragma excelsum* are locally common trees. In many isolated cases *Ocotea usambarensis* is the dominant tree, but heavily harvested for timber. The valleys are particularly rich in species; *Cyathea manniana* is common. At lower elevations common species include *Dracaena steudneri*, *Neoboutonia macrocalyx*, and introduced trees of *Khaya nyasica*.

At higher elevations the main tree species include *Ocotea usambarensis*, *Agauria salicifolia*, *Rapanea melanophloeos* and *Syzygium guineense* to 1 600 m. Above this elevation *Podocarpus latifolius* becomes dominant with *Syzygium standthii*. Towards the top *Maytenus acuminata*, *Bersama abyssinica* and *Dombeya torrida* become typical besides the ericaceous scrubs. *Olea capensis* and *Juniperus procera* indicate the dry montane forest belt.

The forest is very rich in epiphytic and terrestrial bryophytes and lichens. The shrub layer is also rich in species. It is particularly rich in rubiaceaceous shrubs like *Pavetta*, *Psychotria*, *Chassalia* and *Pauridiantha*. Endemics or near-endemics include *Impatiens mazumbaiensis*, *Polystachya*, *Pavetta mazumbaiensis*, so that this forest is important as the type locality for these taxa. Others in the shrub layer include *Tabernaemontana* and *Whitfieldia*. *Costus*, *Aframomum*, *Calanthe*, and the tall *Ensete ventricosum* are frequent forbs.

Mazumbai is perhaps the finest example of remaining primeval forest on the West Usambaras — a forest jewel to be preserved in

Northern Tanzania. When we were there in April 1991, there was, however, a lot of forest clearing for fields and tree felling for timber, especially *Podocarpus* and *Ocotea*.

#### Northern Province

Mt Meru, W slope. In contrast to the old crystalline rocks of the West Usambaras, Mt Meru is a volcanic mountain of more recent origin, with richer soils and poorer flora. *Russula* specimens were found only in exotic *Pinus* plantations at an elevation of 1 900 m.

### Miombo woodlands

#### Southern Highlands Province

Mbozi lies on a 1 600 m high plateau with isolated hills. Fertile clay loam soils with good drainage dominate. Much of the original vegetation is cleared for fuel wood, building poles and for cultivation. The woodland remnants are mainly composed of shrubs of *Combretum*, *Isoblerlinia angolensis*, *Julbernardia paniculata* and locally common are *Brachystegia floribunda*, *B. spiciformis* and *Uapaca pilosa*. *Hyparrhenia* and *Cymbopogon* are common grasses of the deciduous woodland. The herbaceous shrubs and annuals include *Psychotria* and *Dyschoriste* species.

Ipembe Hill, 25 km east of Mbeya town, lies at an elevation of 1 760–1 840 m. Soil is clay loam with good drainage, reddish brown on the uplifted volcanic hill. Vegetation is heavily grazed deciduous woodland with scattered trees of *Uapaca kirkiana*, *Brachystegia* species, and *Parinari curatellifolia*. The few shrubs include *Clusia abyssinica*, which is an indicator of old forest areas. *Peucedanum heracleoides*, *Triumfetta*, and *Lactuca* species are common herbs. All grasses had been grazed to the ground.

#### Lake Province

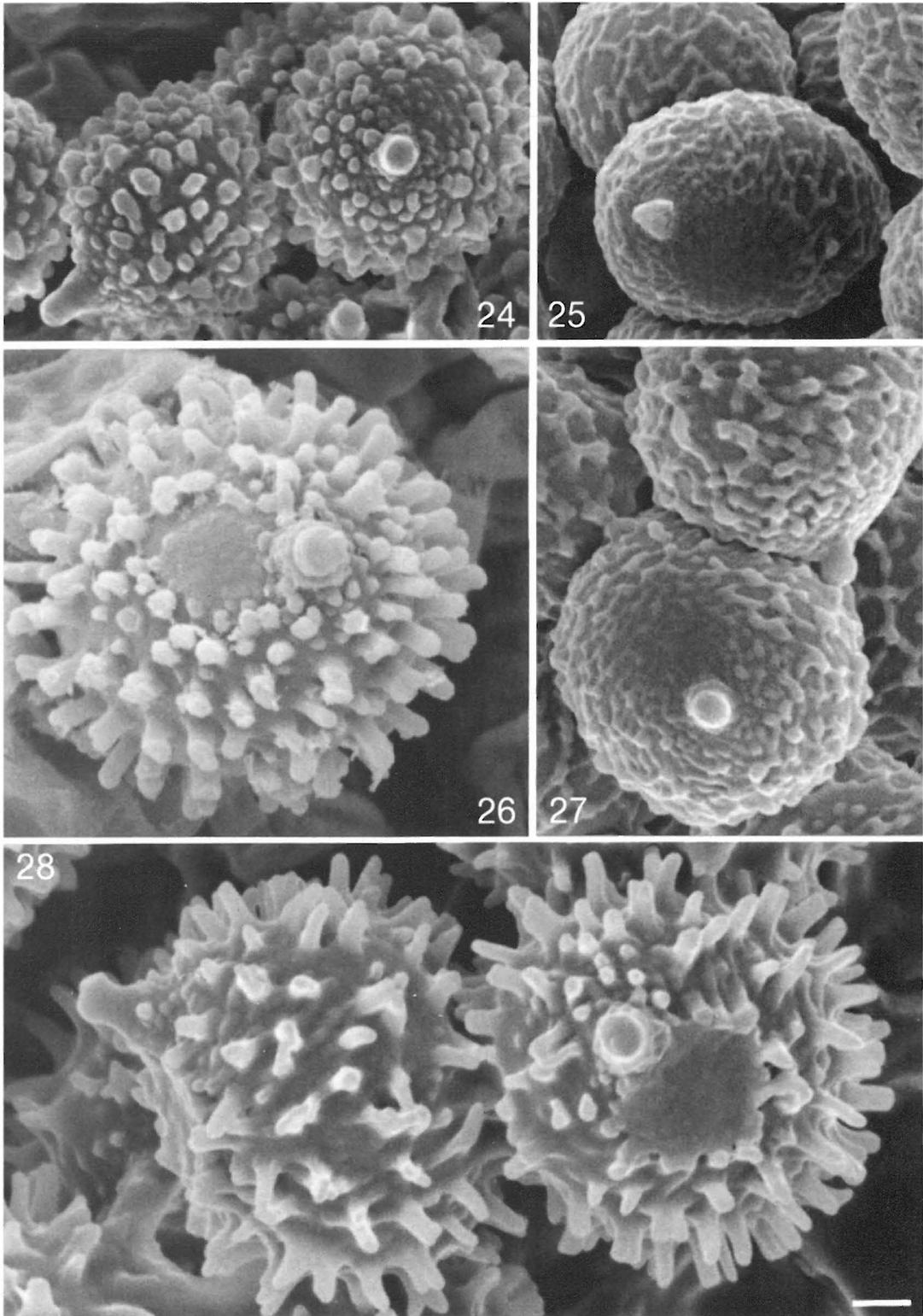
Buharahara, a few kilometres west of Geita, lies at an elevation of 1 250 m. A hill slope with black soils was visited. Deciduous woodland is composed of *Combretum molle*, *C. collinum*, *Terminalia sericea*, *Crossopteryx febrifuga*, *Brachystegia* species and *Commiphora africana* as dominant tree species.



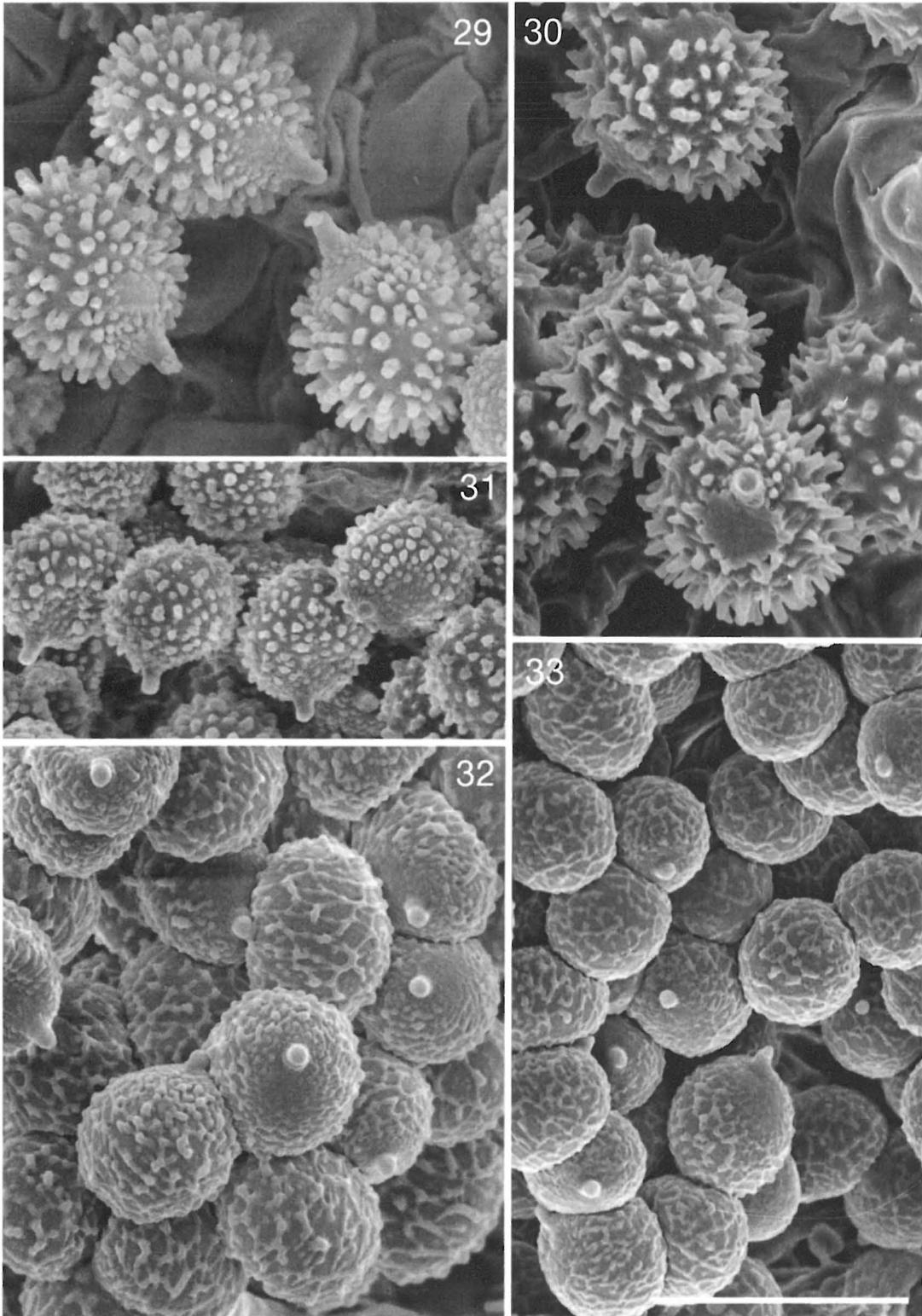
Figs. 17–20. Fruit bodies of Tanzanian *Russula* species. — 17: *R. annulata* s.l. (10113) on left, on right 4 fruit bodies of *R. acriannulata* (type). — 18: *Russula echinosperma* (913). — 19: *R. congoana* (1040). — 20: *R. ciliata* (1119).



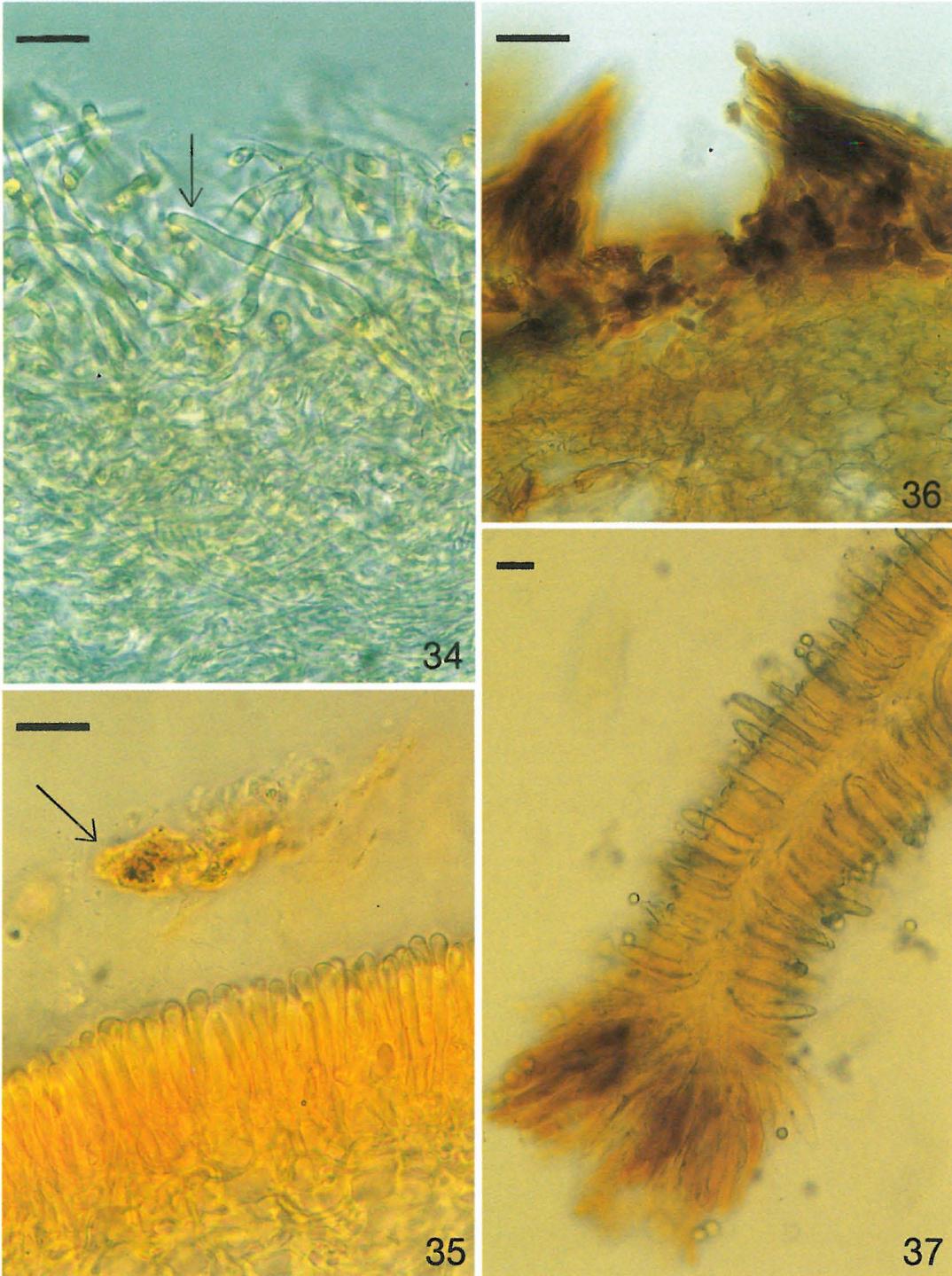
Figs. 21–23. Fruit bodies of Tanzanian *Russula* species. — 21: *R. hiemisilvae* (type). — 22: *R. phaeocephala* (1007a). — 23: *R. liberiensis* (755) above, *R. heimii* (745) below.



Figs. 24–28. Spore ornamentation as seen with scanning electron microscope. — 24: *Russula tanzaniae* (type). — 25: *R. sublaevis* (1105b). — 26: *R. acriannulata* (type). — 27: *R. tenuithrix* (type). — 28: *R. usambara*e (type). Bar = 1  $\mu$ m.



Figs. 29–33. Spore ornamentation as seen with scanning electron microscope. — 29. *Russula acriannulata* (type). — 30. *R. usambarae* (type). — 31. *R. tanzaniae* (type). — 32. *R. tenuithrix* (type). — 33. *R. sublaevis* (1105b). Bar = 10  $\mu\text{m}$ .



Figs. 34–37. Microscopic details. — 34: *Russula tenuithrix* (type). Detail of densely interwoven hyphal extremities of suprapellis in pileus center. In foreground (arrow) a dermatocystidium ascending from subpellis. — 35: *R. cellulata* (1105a). Remark debris (arrow) showing mucus layer on top of suprapellis. — 36: *Russula subfistulosa* (10121). Section through pileipellis showing clusters of hyphal extremities. — 37: *Russula subfistulosa* (10121). Detail of a section near lamella edge showing very abundant cystidia on sides of lamella which are well characterized by their abundant contents and sometimes very deeply inserted in lamellar trama. Lamella edge is entirely occupied by large pigmented marginal cells which are in all respects similar to hyphal extremities of pileipellis. Bar = 20  $\mu$ m.

### Western Province

Wendele, about 30 km west of Kahama, lies at the altitude of ca. 1 200 m. The topography is flat to undulating with a few small rocky hills. Sandy clay loam soils with imperfect drainage prevail, having a high water table which supplies water to wells that have been dug. The deciduous woodland is mainly composed of *Brachystegia* species, *Combretum*, *Boswellia*, *Pterocarpus angolensis*, *Pseudolachnostylis maprouneifolia*, *Xeroderris stuhlmannii* and a few species of *Strychnos*.

Mpunze Forest Reserve, about 40 km SW of Kahama town, lies at an elevation of 1 150 m. Topography is undulating with a few stony hills. Reddish brown sandy clay soils prevail. Vegetation is deciduous woodland with *Brachystegia*, *Combretum*, *Crossopteryx*, *Catunaregam*, *Annona senegaensis*, *Strychnos*, *Pterocarpus angolensis* and many saplings especially of *Pterocarpus*. The bushy *Combretum* vegetation appears frequently, as well as some *Acacia* bushland. (The mushrooms were completely absent in *Acacia* bushland). Emergent palms of *Hyphaene petersiana* occur occasionally in open vegetation on patches of alkaline sandy clay brown soils with a high water table (no mushrooms under them).

Lulanguru, 20 km W of Tabora, lies at an elevation of 1 100 m. Topography consists of undulating land with isolated hills. Soil is brown sandy loam with a discontinuous iron pan. Vegetation is deciduous woodland. Common tree species include *Brachystegia*, *Combretum*, *Antidesma*, *Anisophyllea*, *Annona*, *Ochna*, *Lonchocarpus*, *Terminalia*, *Vitex*, *Strychnos*, *Lannea* and shrubs like *Dichrostachys* and the liana *Strophanthus kombe*.

### Edibility

#### Edibility of *Russula* species in Tanzania

After 81 complete interviews and several shorter inquiries we have come to the conclusion that habits of mushroom use within each individual tribe are always very uniform, but differ greatly between tribes inhabiting different areas. Most of the rural Tanzanians include mushrooms in their diet. Of the 28 tribes queried thus far only the following reject use of mushrooms: the Chagga, Maasai, Meru, and Arusha. The information compiled from the interviews will be published after the fourth and last collecting trip in 1993.

In neither of the montane areas visited are *Russula* species used for food. Mt Meru in Northern Province is inhabited by Arusha and Meru people who reject all mushrooms. In Mazumbai in the West Usambara Mountains people belong to the Sambiaa tribe. We made several collecting forays there with local people and saw many specimens of *Russula*. All were considered inedible, although Sambiaa people eat a wide variety of different mushrooms even including some polypores.

In the miombo woodland areas we visited, *Russula* were usually considered edible, but not all species. The interviews from that area were, however, so few that only preliminary conclusions can be drawn. Fresh *Russula* specimens were displayed and their edibility was discussed during 12 interviews with people from the following tribes: the Bena, Nyiha, Safwa, Nyamwezi, Sumbwa and Sukuma (see Fig. 4).

Most of the interviewees chose the same practice for identification that is familiar to *Russula* researchers all over the world. They broke the specimen, smelt and tasted it before stating their opinion. Some species were edible, some were inedible. Some interviewees treated several *Russula* species as a group, explaining that certain species have many colour variations. On the other hand some brownish species of *Russula* were in the Sukuma language called Kansalaghe, which is a general name for inedible or poisonous mushrooms. The vernacular names and edibility or inedibility from the interviews are added after the descriptions of the species.

We could not discover on which characters the edibility of *Russula* species was based.

People were asked to estimate the deliciousness for food of different mushrooms on a scale from 1 to 3. Usually *Termitomyces* species got the best ratings. Species of *Russula* were obviously rated average. Only twice was a *Russula* species judged delicious with three points and twice valued lower, with only one point.

#### Edibility of *Russula* species elsewhere

In other countries of tropical Africa many *Russula* species are appreciated and intensively sought after as food. From Malawi Williamson (1975) and Morris (1984, 1987, 1990, 1992, 1993) have recorded several edible *Russula* species with vernacular names. Some of the species are sun-dried or parboiled before

cooking. Pegler and Pearce (1980) and Pearce (1981) state that in Zambia the family Russulaceae accounts for a significant proportion of mushrooms, but many species are considered inedible owing to their peppery or otherwise unpleasant taste. Despite this fact, dried mushrooms offered for sale in town markets during the dry season consist mainly of Russulaceae, together with chanterelles. In some parts of Zambia, species of *Russula* are smoked before storage. In Zaïre *Russula* is one of the genera most often eaten (Parent & Thoen 1977). Buyck (1989e) lists in his work on the genus *Russula* several species used for food by natives in Central Africa.

In the book on common names of edible mushrooms in various languages Chandra (1989) states that many species of *Russula* are consumed by the Slavic people of eastern Europe. In Russia, as well, many acrid species are considered edible when salted (Serzanina & Zmitrovic 1978). A rule that nearly all species of *Russula* are edible, but the acrid ones must be parboiled, is common among some non-Slavic East European nations, at least in Finland (Korhonen 1989) and Estonia (Kalamees 1966, 1976). Kalamees (1966) considers the very acrid *Russula emetica* poisonous when fresh, but edible when boiled. For young specimens it is recommended they be boiled twice, and after that they are very tasty when marinated.

The Italians view *Russula emetica* with suspicion, because it contains some thermolabile compounds which irritate the digestive system (Fenaroli 1964, Auguadri et al. 1984). They state that acrid taste is a sufficient indication to avoid a *Russula*. In Germany (Haas 1982) a taste-test is always recommended before using any *Russula* species for food. In Czech and Slovakia (Kotlaba 1980, Svrček et al. 1984) the situation is the same, but Romagnesi (1962) thinks that some acrid species of *Russula* can be used in small amounts as a spice. Anglo-American mushroom guides (Phillips 1991, Miller 1978, Groves 1962) recommend that bitter *Russula* species be rejected. Stadelman et al. (1976) report *R. emetica* to contain muscarine and epi-muscarine. Bresinsky and Besl (1990), however, consider such findings doubtful. In a Swedish book on poisonous mushrooms (Persson et al. 1987), *R. emetica* receives a straight-forward characterization as poisonous. Its Swedish name, gift-kremla, means literally a poisonous *Russula*.

In China several species of *Russula* are consumed and can be often purchased in market places (Yu-Cheng Dai, personal communication). *R. emetica* is considered poisonous also in China (Xie et al. 1986). One species, *Russula subnigricans* Hongo, is considered to be deadly poisonous (Anonymous 1991), causing the following symptoms: nausea, dizziness, weakness, muscular and stomach pains, unconsciousness and sometimes death.

In Japan many *Russula* species are considered edible (Imazeki et al. 1988). *Russula subnigricans* is there also reported to be deadly poisonous. Imazeki et al. (1988) and Hongo (1960) give the following symptoms of poisoning: nausea, dysentery with bloody urine, constriction of the pupils, weakening of pulse, unconsciousness and death after a couple of days. Eating of 2–3 fruitbodies can be fatal.

## Discussion

The high diversity of the African Russulae is well illustrated in the present material by the amazing amount of 21 *Russula* species found among only 36 randomly gathered specimens. Many more species can be expected to be found in Tanzania, especially in large areas of the woodlands dominated by ectomycorrhizal trees belonging to such genera as *Brachystegia*, *Julbernardia*, *Isobelinia*, and *Uapaca*.

There is surprisingly close agreement between the microscopic features of the Tanzanian collections and those that were described by Buyck (1989e, 1993b) on material from other tropical African countries of the same species.

Buyck (1993a) is convinced that as far as indigenous African vegetation is concerned, all *Russula* species are native. The few exotic species of the Russulaceae are in tropical Africa always associated with *Pinus* plantations and appear to be unable to extend the type of their hosts by invading the natural forest. The native *Russula* species seem to be incompatible with plantations of exotic trees.

Virtually nothing is yet known about host specificity of species of *Russula* or any other ectomycorrhizal species in tropical Africa (Buyck et al. 1993). A large number of *Russula* probably exhibit a very wide host range and are found over large areas within either woodland vegetation or rain forest. It is not clear whether some species occur both in the rain forest and in the surrounding woodlands, but if that happens it

is certainly not a frequent phenomenon. This is also confirmed by the Tanzanian collections: the lower montane rain forest appears to be principally inhabited by *Russula* species described from the equatorial rain forest, whereas collections from the miombo woodlands involve mostly species that are known only from the Zambesian woodlands and have not yet been found in the rain forest area.

We cannot yet make any general rule about the edibility of *Russula* species in Tanzania. On our next trip we intend to pay special attention to ways that people judge *Russula* species. Do they choose them mainly by the colour or smell or taste of a species? Don't they mind the acrid taste, and if so, does the taste disappear after boiling?

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