

## NEW OR INTERESTING RAMARIA TAXA FROM AUSTRALIA

R. H. PETERSEN\* & R. WATLING

**ABSTRACT.** New taxa of *Ramaria* subgenus *Laeticolora* are proposed: *R. stuntzii* var. *gelatinosa*, *R. xanthosperma* var. *australiana*, *R. watlingii*, *R. subtilis* var. *microspora*, *R. versatilis* var. *latispora*, and *R. pyrispora*. Notes on other taxa of the subgenus, as well as on *R. australiana* (subg. *Ramaria*) are included.

Some years ago, the senior author was fortunate to spend a few weeks in south-eastern Australia, collecting fungi in New South Wales, Victoria and South Australia and some of the resultant data were subsequently published (Petersen, 1978a,b,c, 1979, 1983, 1986a; Corner, 1986). Additional material included several collections of *Ramaria*, which were supplemented by specimens and notes made by the junior author during two field trips to Australia. The records below combine many of these collections, as well as herbarium material from E, MELU, DAR, and ADW.

Not all the taxa seen in Australia are included here, as we have not seen all pertinent herbarium material, and several additional new taxa have been recognized but inadequate notes have not permitted their description.

A number of caveats for the reader are in order. First, with the taxonomy of this fungal group (and many others) still relying almost exclusively on macroscopic and microscopic basidiome characters (and macrochemical reactions when available), nomenclatural disposition may well not reflect phylogenetic proximity. For example, *Ramaria xanthosperma* var. *xanthosperma* and var. *australiana* are said to differ only in spore dimensions, but this is based merely on examination of basidiomes (not to mention a hazardously small statistical sample). Were biochemical or genetic analyses to be performed, the two varieties might be found rather dissimilar. Intraspecific taxa described here, therefore, only indicate similarity of basidiome characters, not degrees of relatedness.

Second, superimposed on this probable fallacy, the nomenclatural repetition of epithets in species and infraspecific ranks (i.e. *Ramaria xanthosperma* var. *xanthosperma*) can mistakenly be construed to impart geographic predominance or origin. For example it is tempting to interpret that *R. xanthosperma* is 'a North American taxon', with var. *australiana* as a disjunct. In fact, infraspecific epithets merely indicate a chronology of publication, and carry no taxonomic or phylogenetic information. It cannot be inferred that variety *xanthosperma* evolved first, nor that the species originated in North America.

Third, compounding the first point above, those taxa distributed in Australia and extra-limital regions (predominantly North America) must have been forced into new mycorrhizal associations regardless of their geographic migrational direction. The *Eucalyptus* or sclerophyll forests of Australia are not similar to the mixed coniferous or mixed coniferous-angiosperm forests of western or eastern North America. It is little wonder that, even if infraspecific taxa are considered to be related, some morphological changes accompanied significant geographical separation and shifts in mycorrhizal symbionts.

\*Botany Department, University of Tennessee, Knoxville, Tennessee, USA 37916.

Finally, with so many non-native plants introduced into Australia, it is difficult to ascertain which fungi are native and which are introduced. This is especially true when notes on forest types are not included as part of label data on herbarium specimens. Such details are not commonly noted, but no claim can be made that any of the taxa proposed below as new are native. Only further collecting and documentation will solve such problems, but it is hoped that by offering these data a stimulus will be given to Australian collectors.

We find it interesting that all the infraspecific taxa described below are most similar to North American organisms. With knowledge of the Indian and Chinese floras growing rapidly, and that of New Zealand already outlined, it would seem logical to assume that some Australian taxa would resemble those from these places, but as yet this does not appear to be so.

In the text the following abbreviations are used: FSW = aqueous ferric sulphate; FCL = aqueous ferric chloride; GUA = tincture of guaiac; PYR = aqueous pyrogalllic acid; PHN = phenol; ANO = aniline oil mixed with water; ANW = aqueous  $\alpha$  naphthol; KOH = aqueous potassium hydroxide; NOH = aqueous ammonium hydroxide; IKI = Melzer's reagent. Recipes for these reagents may be found in Marr & Stuntz (1973) and Marr (1968). Colours in quotation marks are from Ridgway (1912), while those with alpha-numeric citation are from Kornerup & Wanscher (1967).

**1. *Ramaria anziana*** Petersen in DSIR [New Zealand] Bull. 236: 104 (1988).

*Basidiomes* up to  $9 \times 4$  cm, broadly obconical to subspherical. *Stipe* single and then slender (to  $15 \times 7$  mm) or falsely fasciculate (single but with internal organization indicative of several subunits), and then up to  $30 \times 20$  mm, smooth to pruinose, sometimes with abortive branch systems of various sizes, white where protected to pale fleshy cream-colour ('capucine buff'); *flesh* off-white, minutely marbled, not slippery. *Major branches* 2, ascending,  $\pm$  terete, upward concolorous with branches. *Branches* in 4-6 ranks, slender, terete, salmon to pinkish salmon ('bittersweet pink,' 'light salmon orange') or pastel orange ('capucine orange'); *axils* narrowly rounded; *internodes* diminishing gradually upward; minute areas around soil particles vinescent. *Apices* slender, dichotomous, awl-shaped, bright yellow to pale clear yellow ('apricot yellow,' 'pale orange yellow'). *Taste and odour* negligible.

*Macrochemical reactions:* FSA, FCL ++; GUA +; KOH, NOH + orange; ANO, ANW, PYR, IKI -.

*Stipe tramal hyphae*  $3-14 \mu\text{m}$  diam., irregularly thick-walled (wall  $1-3.5 \mu\text{m}$  thick), gnarled, clamppless, interwoven, free; ampulliform septa up to  $11 \mu\text{m}$  broad, symmetrical, not unusually thick-walled, delicately ornamented; gloeoplerous hyphae not observed. *Tramal hyphae of upper branches*  $3-14 \mu\text{m}$  diam., hyaline, thick-walled (wall usually  $0.5 \mu\text{m}$  thick, locally to  $1.5 \mu\text{m}$  thick), clamppless, parallel, free to adherent; cells subtrilete; ampulliform inflations and gloeoplerous hyphae not observed. Subhymenium extensive, pseudoparenchymatous. *Hymenium* thickening, with occasional amorphous material deposited between basidia; *basidia*  $60-70 \times 8-10 \mu\text{m}$ , clavate, clamppless; contents homogeneous, subrefrinct when young, multigranular at maturity; sterigmata 4, stout, peripheral. *Spores*  $7.2-9.4 \times 4-5 \mu\text{m}$  ( $E = 1.54-2$ ;  $E^m = 1.84$ ;  $L^m = 8.28 \mu\text{m}$ ), cylindrical, hardly roughened in profile; contents homogeneous or with one yellowish, delimited guttule; wall to  $0.2 \mu\text{m}$  thick; hilar appendix  $\pm$  papillate, prominent; ornamentation a few small warts and narrow ridges.

Habitat: In tall, open, dry sclerophyll forest, on sandy soil with debris covering, and understorey of *Banksia integrifolia* and *B. serrata*, with *Eucalyptus intermedia* (Bloodwood) and *E. pilularis* (Blackbutt), and *Angophora woodsiana* (Smudgee) (Queensland). In mixed, dry, sclerophyll forest on well-drained soil with understorey of *Acacia dealbata*, and overstorey of *Eucalyptus obliqua* (Messmate), *E. viminalis* and stringy barks (e.g. *E. macrorhyncha*) and previously burnt-over area with *E. obliqua* and *E. radiata* (Narrow-leaved peppermint) (Victoria). Two collections (Watling 10676, 10704) from ACT in wet sclerophyll forest with *Dicksonia*, *Olearia agrophylla*, *Bedfordia salicina* and *Pomaderris aspera*, with *Eucalyptus fastigiata* (Brown Barrel) and *E. viminalis* (Manna gum) are very close if not conspecific with *R. anziana*, although their habitat was very different. Further collecting in this vegetational type is required.

Specimens examined: NEW SOUTH WALES: Newington, 11 vi 1914, Cleland 16081 (ADW); Hawkesbury River, 16 vi 1912, Cleland 16083, 16085 (ADW); sine loc., Cleland 16086 (ADW); Newington, vi 1914, Cleland 16084 (ADW); Milson Island, Hawkesbury River, v 1913, Cleland 16082 (ADW) (all collected as *Clavaria formosa*). SOUTH AUSTRALIA: Mt Lofty, 26 vi 1921, Cleland 16003 (ADW, as *Clavaria flaccida*). VICTORIA: Wombat State Park, 28 iv 1982, Watling 14707 (E); Kinglake West, road to Yea, 12 vi 1977, Weste & Swart, RHP VIC10 (TENN); Olinda, Melbourne, 12 v 1982, Watling 14827 (E); Gembrook, Melbourne, 11 v 1982, Watling 14828 (E). QUEENSLAND: Cooloola sand-dunes, vic. Gympie, 31 v 1982, Watling 16229 (E).

The species epithet is derived from the initial letters of Australia and New Zealand from where material was obtained (Petersen, 1988b). Material from the two countries differs qualitatively but hardly quantitatively. Basidiome colour of New Zealand collections tends to be slightly less pink and more yellow-salmon, but apices are quite similarly pigmented across the geographic range. Spores of New Zealand collections were  $(7.6-8.6-10.4 \times 4-5 \mu\text{m})$  ( $E = 1.62-2.27$ ;  $E^m = 2.06$ ;  $L^m = 9.10 \mu\text{m}$ ), but otherwise identical to those from Australian specimens.

Fawcett (1939) described basidiomes (under *Clavaria flava* var. *aurea* Coker) as often quite large (to 25 cm broad). Such large individuals have not been seen by us, but the species is easily recognized by: (1) salmon/yellow colour scheme; (2) usually falsely fasciculate stipe; (3) clampless septa; (4) semi-translucent branch flesh; and (5) small, cylindrical spores. It differs from *R. ochraceo-salmonicolor* (Cleb.) Corner in more slender stature, and from *R. formosa* (Pers.; Fr.) Quel. by the hard, dry flesh, clampless septa and smaller spores.

One collection (Watling 14827), very similar in stature, colour, and micro-structure to others from Australia, has unusually slender spores  $(8.3-11.5 \times 3.6-4.3 \mu\text{m})$ ;  $E = 2.25-2.91$ ;  $E^m = 2.48$ ;  $L^m = 9.73 \mu\text{m}$ , but differs in no other way from more typical material.

**2. *Ramaria capitata*** (Lloyd) Corner in Ann. Bot. Mem. 1: 565. 1950. Fig. 1A. Syn.: *Clavaria capitata* Lloyd in Mycol. Notes 7: 1107. 1922.

*Capitoclavaria capitata* Lloyd (as 'McGinty') in Mycol. Notes 7: 1107. 1922. nom. inval. (Art. 34.1).

*Basidiomes* up to  $7 \times 5$  cm, obovoid. *Stipe* up to  $10 \times 10$  mm, small, rounded at base, single, solid, often rooting, off-white, tomentose between substratum particles, with a few abortive clusters; *flesh* white, solid, not marbled or gelatinous. *Major branches* 3-4, usually arising below substratum level, pruinose on below-ground portions, rugulose, off-white to pale yellow ('cream color'). *Branches* in 5-7 ranks, ascending,  $\pm$  terete, buff-coloured to yellow ('Naples

yellow'); *axils* narrowly rounded; *internodes* diminishing gradually upward. *Apices* pileate, minutely leotoid, watery or glistening, yellow to ochraceous yellow ('warm buff', 'buff yellow'), sometimes flushed with lavender over distal 4–5mm and purple apically, apparently when bruised. All parts slowly brunnescent ('Hay's russet') where bruised or handled. *Taste* and *odour* not recorded.

*Macrochemical reactions*: FCL ++; GUA, PYR +; ANO, ANW, IKI, NOH, KOH –.

*Tramal hyphae* of upper branches 3–9µm diam., hyaline, thin- to thick-walled (wall locally thickened to 0.5µm in banded, flattened-torulose pattern), clampless, parallel, not adherent or agglutinated; ampulliform septa to 11µm broad, narrowly alliform, locally thick-walled (wall to 0.5µm thick), unornamented or with delicate stalactitiform ornamentation; gloeoplerous hyphae as narrow, undelimited lengths, with abrupt inflations, subrefrinct. *Subhymenium* extensive, tightly interwoven. *Hymenium* thickening, restricted to lateral branch surfaces, with transition zone under pileus of sterile, clavate hyphal tips; *basidia* 70–85 × 10–13µm, broadly clavate, clampless; contents initially univacuolate, later multivacuolate and granular; sterigmata 4, stout, curved. *Pileus surface* a turf (trichodermium) of leptocystidial hyphal tips to 80µm long; hyphae 3–5µm diam., hyaline, thin-walled, clampless, undulate, often lobed or branched once, sometimes subtly subcapitate. *Hymenium* restricted to lateral branch surfaces, with transition zone under pileus of sterile, clavate hyphal tips. *Spores* (Fig. 1A) 9.7–15.1 × 5–7.2µm ( $E=1.76$ –2.77;  $E^m=2.08$ ;  $L^m=11.84$ µm), broadly comma-shaped to cylindrical, usually inflated distally, minutely roughened in profile; contents homogeneous or obscurely 1-guttulate, the guttule hardly refringent; wall up to 0.2µm thick; hilar appendix abruptly curved, prominent; ornamentation of many scattered small warts and short, lobed ridges.

*Habitat*: On bare, gravelly soil with scattered eucalypt debris in dry, open sclerophyll forest of *Eucalyptus rossii* and *E. manifera* var. *maculata*, and on bare soil with thorny understorey, with *E. obliqua* and *E. radiata* (south-eastern Australia). Amongst litter, in dry sclerophyll forest with *Banksia*, *E. calophylla* (Marri) and *E. marginata* (Jarrah) and in grassy/bare areas with *E. gomphocephala* (Tuart), *Casuarina fraseriana* and *E. marginata* (Western Australia).

*Specimens examined*: AUSTRALIAN CAPITAL TERRITORY: Cowan, near Millinglo Gorge Creek, 28 iv 1974, Watling 10469 (E). NEW SOUTH WALES: Mosman, 4 v 1912, collector unknown, ex NSW, no. 28687 (DAR). SOUTH AUSTRALIA: Echunga, 12 vi 1939, Cleland 16040 (ADW); Adelaide, vi 1977, collector unknown (TENN no. 41240). VICTORIA: Gembrook, near Melbourne, 11 v 1982, Watling 14806, 14834 (E); Kinglake, v 1936, Fawcett 7036F (MELU, TENN); Road to Yea, 12 vi 1977, Weste & Swart, (TENN no. 41224). WESTERN AUSTRALIA: Perth, east of Kalamunda, 11 v 1974, B. Dell & Watling, [Watling 10207] (E); Pemberton, Bunbury Area, 14 v 1974, Watling 10248 (E).

McLennan's notes accompanying the 'co-type' specimen at MELU (no. 7061F) are instructive and read: 'Mr. Semmens was apparently the first person to collect this sp. in Australia; he sent specimens to Lloyd. He forwarded to Fawcett a copy of his field notes & an extract from Lloyd's letter to him.' By Semmens: '[Basidiomes] whitish, pale, flesh colour. Tips of branches dilated into somewhat gelatinous mamillate caps. Smooth, slightly rugose . . . stem fleshy, thick, solid . . .'

Spore dimensions are extremely variable when several collections are

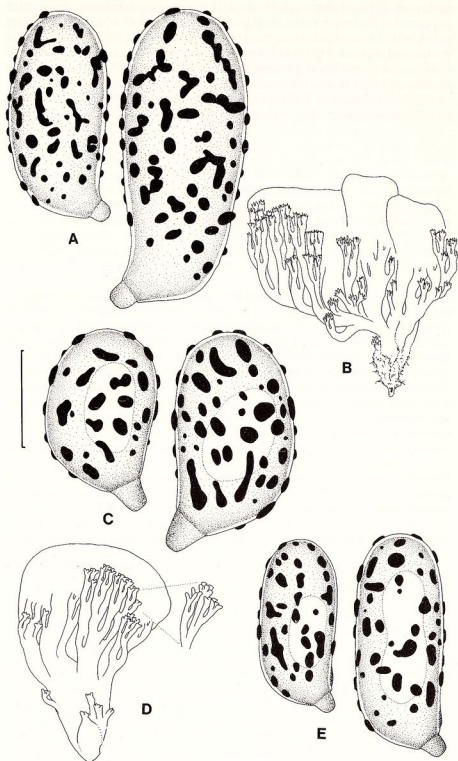


FIG 1. *Ramaria capitata*: A, spores. *R. pyriformis*: B, basidiome; C, spores. *R. subtilis* var. *microspora*: D, basidiome; E, spores. A from MELU F7063; B, C from Watling 14800; D, E from Watling 14825. Scale (for spores only) = 5µm.

examined. Table 1 summarizes the data. In most samples there are spores at the upper end of the length range, and that dimension (and  $E^m$  and  $L^m$  accordingly) varies with the ratio of long to short spores. In *Watling* 14834, no long spores were found, while in TENN 41224 no short spores were seen. However, TENN 41240 and *Fawcett* 7063F presented intermediate spore dimensions, so that a continuum could be identified and not a bimodal range. Ordinarily, we would be disposed to segregate TENN 41224 as a separate infraspecific taxon, but all other characters agree well with typical material.

TABLE 1  
Spore data for *Ramaria capitata*

Specimen	Dimensions ( $\mu\text{m}$ )	$E^m$	$L^m$
<i>Watling</i> 14834 (E)	9.7–12.6 $\times$ 5–6.1	1.97	10.74
no. 41240 (TENN)	10.8–15.1 $\times$ 5.8–7.2	1.98	12.30
F7063 (MELU)	10.4–15.1 $\times$ 5–6.5	2.33	12.76
no. 41224 (TENN)	13–17.3 $\times$ 5–6.5	2.71	14.72

The leotiid apices of *R. capitata* have presented a taxonomic problem for the few workers interested in the genus. *Fawcett* (1939) discussed the phenomenon, but no one has examined the structures carefully. That they are a consistent feature of the species is without question. At least six specimens have been seen with identical branch apices. In most cases, the tips become connate so there is a confluent shelter over several branches simultaneously. The confluent growth pattern may be enhanced by a mucilaginous or gelatinous quality (see *Semmen's* note above, and notes with TENN 41240), although no agglutinating material is observable microscopically. Moreover, the pileus surface is neither fertile nor undifferentiated. Instead, it is an obvious trichodermium of leptocystidial elements extending to the margin of the pileus, but not under it. A layer of sterile, clavate hyphal tips (?basidioles) extends from the pileus margin to the uppermost vertical sides of the branches, where a fertile hymenium begins abruptly. *Fawcett* (1939) reported that the pileus surface became fertile tardily, but this has not been observed by us.

As pointed out by *Fawcett* (1939), *Lloyd* did not explicitly state his species to be new. Likewise, *Lloyd* (1922) suggested that the species could be placed in a separate genus, *Capitoclavaria*, failing to explicitly propose it. Moreover, by ascribing the new genus to 'Prof. McGinty' (*Lloyd's* facetious pseudonym), he indicated that the name was introduced for fun, not for science. Under the ICBN the name is not validly published.

Two collections (*Watling* 14806, 14834 in E) are accompanied by notes indicating that the upper branches and tips were suffused with lavender to purple coloration. In one (*Watling* 14834) the colours were merely reported as such, while in the other (*Watling* 14806), the lavender colour was linked to handling or bruising of the specimen. From notes accompanying TENN 41224, this is a vinous response, not a naturally occurring pigmentation. In the last specimen, the basal branches were almost completely suffused with lavender, while upwards only halos were visible around dirt specks. No supporting characters can be found by which to further separate the vinctuous collections from the typical yellow-tipped basidiomes, so they are left together.

3. *Ramaria gelatinosa* (Coker) Corner var. *oregonensis* Marr & Stuntz in Biblioth. Mycol. 38: 95 (1973).

*Basidiomes* up to  $12 \times 14$  cm, spherical to depressed-spherical. *Stipes* either very small ( $< 5 \times 5$  mm) or not, almost immediately copiously branched, or falsely fasciculate (several bound together by connate growth so as to appear superficially single), off-white at very base, concolorous with branches upward; flesh firmly gelatinous, translucent inward, opaque in rind tissues, yellow-ochre ('cinnamon buff'). *Major branches* many (if stipe is considered small and single) or few (if stipes are considered fasciculate), not terete, lobed in cross-section, pastel cinnamon ('pinkish cinnamon,' 'cinnamon' or paler where protected, 'Mikado brown' where exposed). *Branches* in 4-7 ranks, terete upward, concolorous with major branches; flesh locally gelatinous, somewhat paler than branch surfaces; *axils* narrowly rounded below, rounded above; *internodes* diminishing gradually upward. *Apices* minutely crested, broadly awl-shaped or double-dichotomous, acute, pallid ochre when young ('light ochraceous buff'), concolorous with upper branches by maturity ('pinkish cinnamon'). *Odour* negligible, perhaps fresh; *taste* raphinoid or bitter-fabaceous.

*Macrochemical reactions*: FCL, FSW, GUA ++; ANO, ANW, PYR +; KOH, NOH + ruddy.

*Stipe tramal hyphae*  $2-15 \mu\text{m}$  diam., hyaline, clamped, in two tissue types: (1) hyphae thick-walled (wall to  $2 \mu\text{m}$  thick), in long-fusiform cells arising and ending in narrow ( $2-3 \mu\text{m}$  diam.) clamped septa, inflated up to  $15 \mu\text{m}$  diam., free; and (2) hyphae thin- to thick-walled (wall up to  $0.5 \mu\text{m}$  thick),  $3-9 \mu\text{m}$  diam., agglutinated, liberating agglutinating substance into squash mounts; ampulliform septa to  $13 \mu\text{m}$  broad, hardly inflated, not unusually thick-walled, with extensive stalactitiform ornamentation; gloeoplerous hyphae not observed. *Tramal hyphae of upper branches*  $3-6 \mu\text{m}$  diam., hyaline, uninflated, thin-walled, conspicuously clamped, parallel, often anastomosed, frequently but locally adherent, otherwise free; ampulliform septa and gloeoplerous hyphae not observed. *Hymenium* thickening significantly; *basidia*  $60-70 \times 7-9 \mu\text{m}$ , clavate, clamped; contents obscurely granular; sterigmata 4, stout, curved. *Spores*  $7.9-11.2 \times 5-6.1 \mu\text{m}$  ( $E = 1.47-1.91$ ;  $E^m = 1.65$ ;  $L^m = 9.13 \mu\text{m}$ ), ellipsoid, finely roughened in profile; contents homogeneous, subrefrinct; wall to  $0.2 \mu\text{m}$  thick; hilar appendix up to  $6 \mu\text{m}$  long, very prominent, conical; ornamentation of small scattered warts.

Specimen examined: VICTORIA, Mount Wilson, R.D. 63, 9 vi 1977, J. Walker & Petersen [Petersen VIC8] (TENN).

No significant differences can be found between the sole Australian specimen and the many collections gathered in western North America (by RHP). The taxon is well marked macroscopically by the obviously gelatinous, yellow-ochre flesh and complex structure of the stipe. Microscopically, the presence of clamp connections, agglutinated stipe tramal hyphae and strongly apiculate spores are all diagnostic.

Doty (1944) used the name *Clavaria gelatinosa* Coker for this taxon. Marr & Stuntz (1973) correctly distinguished it from typical material (eastern North America, hyaline to white flesh, single stipe, pallid pink or salmon pink branches, yellow apices), describing var. *oregonensis* as a result. The present authors do not consider the two varieties conspecific.

As the organism is commonly collected in western North America, it might be suggested that it has been introduced to Australia, but there is no firm evidence for this surmise.



**4. *Ramaria lorithamnus* (Berkeley) Petersen in Sydowia 35: 184 (1982).**

Syn.: *Clavaria lorithamnus* Berkeley in J. Linn. Soc. Bot. 13: 169 (1873).

*Ramariopsis lorithamnus* (Berk.) Corner in Ann. Bot. Mem. 1: 644 (1950).

*Clavaria sinapicolor* Cleland in Trans. Roy. Soc. S. Aust. 55: 159 (1931).

*Ramaria sinapicolor* (Cleb.) Corner in Ann. Bot. Mem. 1: 621 (1950).

*Basidiomes* to 9 × 4 cm, spindle-shaped to obconical. *Stipes* to 35 × 7 mm, slender, tapering gradually to an acute base, fasciculate, arising below substratum level, smooth to strigose-tomentose in places, often gnarled, slowly brunnescent where handled or bruised ('cinnamon,' 'Soyal brown,' 'Mikado brown'), off-white; *flesh* off-white, solid, stringy, drying hard. *Major branches* 2, dichotomous, ± terete, ascending, dull yellow ('cream color,' 'cartridge buff'). *branches* in 2-4 ranks, dichotomous, terete, dull yellow to yellow ('maize yellow,' 'colonial buff,' 'cream buff,' 'buff yellow,' 'cream color,' 'pale orange yellow'); *flesh* paler, often hollow; *axils* narrowly rounded; *internodes* diminishing upward. *Apices* awl-shaped, dichotomous, bright greenish yellow ('pinard yellow,' 'mustard yellow,' 'Naples yellow,' 'ochraceous buff'). *Odour* pleasant, faintly aromatic; *taste* negligible.

*Macrochemical reactions:* FCL +; GUA + on stipe flesh,—on branch sections; ANO weakly +; PYR sometimes weakly +; ANW, NOH, KOH, IKI—.

*Tramal hyphae of upper branches* 6-27 µm diam., hyaline, inflated, thin- to thick-walled (wall to 2 µm thick, irregular), clampless, parallel, frequently anastomosed, not adherent or agglutinated; ampulliform septa up to 14 µm broad, hardly inflated, not unusually thick-walled, with local delicate stalactitiform ornamentation; gloeoplerous hyphae not observed. *Subhymenium* rudimentary; hyphae 2-3 µm diam., clampless, hyaline, tightly interwoven. *Hymenium* thickening; *basidia* 45-50 × 7-8 µm, clavate, clampless; contents homogeneous, subrefrangent; sterigmata 4, up to 7 µm long, curved, slender. *Spores* 5.8-7.9 × 4-5 µm ( $E = 1.31-1.91$ ;  $E^m = 1.54$ ;  $L^m = 6.74 \mu m$ ), broad-cylindrical to ovoid, flattened adaxially, roughened in profile; contents obscurely guttulate to distinctly uniguttulate, the guttule refringent; wall to 0.2 µm thick; hilar appendix prominent, truncate; ornamentation of a few scattered low warts.

*Habitat:* In relatively dense shady, wet sclerophyll rainforest with *Arthrospermum muscatum* (Sassafras), *Eucalyptus johnsonii* (Tasmanian yellow gum) and *Phyllocladus asplenifolius* (Celery top pine) overstorey, and understorey of *Acacia dealbata* and *Olearia* (Tasmania).

*Specimens examined:* NEW SOUTH WALES: National Park, 25 v 1919, Cleland 16041 (ADW); Hawkesbury River, 16 vi 1912, Cleland 16078 (ADW); Mount Tomah, 9 vi 1977, Petersen 28766, 28772 (DAR, TENN); Dandanong, 1872, coll. unknown, [Berkeley] (K, holotype of *C. lorithamnus*). SOUTH AUSTRALIA: Mt Lofty, 9 vii 1927, Cleland 15956 (ADW, holotype of *C. sinapicolor*); Mt Lofty, 15 vii 1922, Cleland 15955 (ADW); Humbug Scrub, 29 vii 1960, Cleland 16393 (ADW); Mt Lofty, 26 vi 1952, Hansford 2133 (ADW); Mt Lofty, 13 vii 1952, Hansford 2100, 2165 (ADW); Adelaide Hills, 1923, G. Samuel 2345 (ADW); Mt Lofty, 22 vi 1952, Warcup 2229 (ADW); Greenhill Rd, v 1946, Cleland 8273 (ADW); Waterfall Gully, 1 vii 1945, Cleland 16025 (ADW); Waterfall Gully, 20 vi 1945, Cleland 16105 (ADW); East Torrens, 22 vi 1977, Talbot & Petersen [Petersen SA43] (TENN); National Park, Minna Creek, 21 vi 1977, Talbot & Petersen [Petersen SA18] (TENN). TASMANIA: National Park, above Russell Falls, 17 v 1982, Watling 15093 (E).

Fawcett (1938) briefly discussed *Clavaria lorithamnus* under *C. stricta* (Pers.: Fr.) Quél. Having examined no authentic material (she had collected *C.*



*sinapicolor* Cleland several times), she followed Berkeley's (1873) lead who related it to *C. stricta* and concluded that *C. stricta* and *C. lorithamnus* were synonyms.

Measurements of spores from the type specimen of *R. lorithamnus* (Petersen, 1978) were  $6.3\text{--}8.2 \times 4.8\text{--}5.6\ \mu\text{m}$  ( $E = 1.29\text{--}1.54$ ;  $E^m = 1.44$ ;  $L^m = 7.31\ \mu\text{m}$ ) and from the type specimen of *R. sinapicolor* (Petersen, 1969)  $5.6\text{--}7.4 \times 3.5\text{--}4.5\ \mu\text{m}$ . Several specimens collected in New Zealand (Petersen, 1988), had somewhat larger spores ( $7.9\text{--}9.4 \times 4.7\text{--}5.8\ \mu\text{m}$ ;  $E = 1.56\text{--}1.85$ ;  $E^m = 1.66$ ;  $L^m = 8.75\ \mu\text{m}$ ). Now that several Australian specimens have been examined, the New Zealand material appears incongruous, and some nomenclatural rank for it may be appropriate. Otherwise, New Zealand and Australian specimens differ little.

### 5. *Ramaria pyrispora* Petersen & Watling, sp. nov. Fig. 1 B, C.

Basidiomata multiramosi, ad  $13 \times 6\text{ cm}$ , obpyriforme. Basi ad  $2 \times 1\text{ cm}$ , singulati, cum ramuli abortivi; contusi non-brunnescenti; caro albo, non gelatinoso. Rami et ramuli deorsum pallido-cremea, superne pallido-ochracea. Apices tenui, cum ramuli concolori. Hyphae contextualis fibulatae, crassitunicatae. Basidia  $60\text{--}65\ \mu\text{m}$  longa, clavata, fibulata. Sporae  $7.9\text{--}9.7 \times 5.4\text{--}6.1\ \mu\text{m}$ , ovatae ad obpyriformae, subcorrugatae. Watling 14800 (holo. E).

*Basidiomes* (Fig. 1B) to  $13 \times 6\text{ cm}$ , narrowly to broadly obconical. *Stipe* up to  $2 \times 1\text{ cm}$ , white, tapering to an acute base, strigose to thickly tomentose, with abortive branch systems, involving significant substratum and a few white rhizomorphs when picked; *flesh* solid, dry, sparse, not gelatinous or slippery. *Major branches* several, flaring, ascending, not terete, pale cream colour. *Branches* in 3–7 ranks, arising irregularly, not terete, straw coloured to pale ochraceous (*teste* Watling); *axils* rounded; *internodes* diminishing gradually upward. *Apices* finely divided, clustered, cristate, minutely conical, concolorous with branches or somewhat paler. *Odour* not recorded when fresh, of fenugreek after drying; *taste* not recorded.

*Macrochemical reactions*: not recorded.

*Stipe tramal hyphae*  $2\text{--}6\ \mu\text{m}$  diam., hyaline, thin- to thick-walled (wall locally to  $0.5\ \mu\text{m}$  thick), clamped, very tightly interwoven, free to strongly adherent; ampulliform septa to  $15\ \mu\text{m}$  broad, asymmetrical, alliiiform, thick-walled (wall locally to  $2\ \mu\text{m}$  thick), with gross but very local stalactitiform ornamentation; gloeoplerous hyphae not observed. *Tramal hyphae of upper branches*  $2\text{--}6\ \mu\text{m}$  diam., hyaline, thin- to thick-walled (wall to  $0.5\ \mu\text{m}$  thick), inconspicuously clamped, parallel, free to locally adherent; ampulliform septa to  $10\ \mu\text{m}$  broad, elongate-alliiform, asymmetrical, thick-walled (wall to  $1\ \mu\text{m}$  thick), without ornamentation; gloeoplerous hyphae not observed. *Subhymenium* extensive; hyphae  $1.5\text{--}2.5\ \mu\text{m}$  diam., hyaline, clamped, thin-walled, tightly interwoven. *Hymenium* thickening; *basidia*  $60\text{--}65 \times 7\text{--}8\ \mu\text{m}$ , narrowly clavate, inconspicuously clamped; contents homogeneous, moderately cyanophilous; sterigmata 4, slender, straight, apical. *Spores* (Fig. 1C)  $7.9\text{--}9.7(10.4) \times 5.4\text{--}6.1\ \mu\text{m}$  ( $E = 1.47\text{--}1.70$ ;  $E^m = 1.58$ ;  $L^m = 8.93\ \mu\text{m}$ ), lacrymiform, obliquely pyriform to broadly ellipsoid with a beak-like hilar appendix, inconspicuously roughened in profile; contents deep ochraceous, subrefrinct, sometimes obscurely uniguttulate, the guttules dark, discrete; wall to  $0.2\ \mu\text{m}$  thick; hilar appendix up to  $4\ \mu\text{m}$  long, conical, appearing thick-walled; ornamentation of many small, rounded warts and occasional unoriented ridges.

Habitat: On soil in burn area with mixed understorey, in dry sclerophyll forest under *Eucalyptus obliqua* and *E. radiata* (Victoria).

Specimen examined: VICTORIA: Olinda, near Melbourne, 12 v 1982, Watling 14800 (holo. E).

The stipe stature seems discrete, with numerous abortive systems of various sizes, from very small to almost full-size. Stipe surfaces are tomentose, with several slender, fragile, white rhizomorphs. It is tempting to conclude that the stipe is falsely fasciculate, but there is no evidence for this except the gnarled shape of dried material.

Similarly, the upper branch tramal hyphae are locally adherent, as are stipe tramal hyphae, and the branch flesh has dried to a glassy appearance, all indicative of gelatinous consistency. No agglutinating substance can be seen in microscope mounts, however, and macroscopically, stipe flesh is dry and white, not dark and glassy.

Spore dimensions (and statistics) are unique, hence we are confident in proposing a new taxon on a single collection; the species seems to take up an isolated position. Spore shape is not unlike that of *R. zippelii* (Lév.) Corner and *R. pancarribea* Petersen, in subg. *Echinoramaria*. However, in these species spores are grossly echinulate to pteroid and thick-walled. The spores of *R. pyrispora* are obliquely pear-shaped, hence the species epithet.

Basidiomes of *R. watlingii* (see below) and *R. rubricarnata* Marr & Stuntz form much larger, well-defined stipes and both possess narrower spores. Most similar to *R. pyrispora* is an undescribed taxon from Switzerland, but basidiomes of that species have massive stipes and larger spores ( $10.7-12.5 \times 5.6-6.7 \mu\text{m}$ ). Also unique are the cristate apices which dry somewhat paler than branches, viz. almost grey rather than the usual fleshy ochre.

#### 6. *Ramaria stuntzii* Marr var. *gelatinosa* Petersen & Watling, var. nov.

Basidiomata multiramiosi, ad  $7 \times 6 \text{ cm}$ , circulari ad sphaeropedunculati. Basi ad  $2 \times 1.5 \text{ cm}$ , singulati, cum ramuli abortivi; contusi non-brunnescenti; caro albo, gelatinoso. Rami deorsum rosacei, ramuli superne incarnati vividi. Apices tenui, coccinei. Hyphae contextualis afibulatae, crassi-ad tenuitunicate. Basidia  $65-75 \mu\text{m}$  longa, clavata, afibulata. Sporae circum  $8.5 \times 4 \mu\text{m}$ , ellipsoidae, subcorrugatae (Watling 14799, holo. E).

Basidiomes up to  $7 \times 6 \text{ cm}$ , spherical to sphaeropedunculate. Stipe to  $2 \times 1.5 \text{ cm}$ , discrete, covered with strigose mycelium and white tomentum below ground, involving copious substratum on picking, with common abortive clusters, slightly yellowish in some areas, pale pink upwards; abortive clusters white where protected; flesh distinctly gelatinous, probably off-white, drying hard, cartilaginous, marbled. Major branches several, hardly terete, somewhat divergent, pink to pale pink, drying deep ochre. Branches crowded, somewhat divaricate, pink to bright pink; axils narrowly rounded; internodes short throughout, diminishing somewhat upward. Apices crowded, cuspidate, double-dichotomous, minute, bright red, perhaps abruptly pale where protected. Odour weakly of fenugreek when dry; taste not recorded.

Macrochemical reactions: not recorded.

Stipe tramal hyphae  $4-11 \mu\text{m}$  diam., hyaline, thin- to thick-walled (wall to  $0.5 \mu\text{m}$  thick), heavily agglutinated, more or less parallel, liberating agglutinating substance into 2% aqueous KOH squash mounts; ampulliform septa to  $14 \mu\text{m}$  broad, bluntly alliform, locally thick-walled (wall to  $1 \mu\text{m}$  thick) with local, delicate stalactitiform ornamentation; gloeoplerous hyphae not observed.

*Tramal hyphae of upper branches* 3–7 µm diam., hyaline, thin-walled, clampless, agglutinated, strictly parallel, liberating agglutinating substance in 2% KOH squash mounts. *Subhymenium* extensive, pseudo-parenchymatous. *Hymenium* thickening; *basidia* 65–75 × 9–10 µm, clavate, clampless; contents homogeneous, subrefrinct; sterigmata 4, spindly, curved. *Spores* approximately 8.5 × 4 µm, narrowly ellipsoid, roughened in profile; contents 1–several-guttulate; wall up to 0.2 µm thick; hilar appendix not prominent; ornamentation not observed. *Habitat*: Mixed, tall, dry sclerophyll forest, on dry, well-drained soil under *Eucalyptus obliqua*, *E. viminalis* and stringy barks (especially *E. macrorhynchia*) and previously burnt-over soil, in dry sclerophyll forest, with *E. obliqua* and *E. radiata* (Victoria).

Specimens examined: VICTORIA: Wombat State forest, 28 iv 1982, Watling 14711 (E); Olinda, 12 v 1982, Watling 14799 (holo. E).

*Ramaria stuntzii*, known only from western North America, is recognized by its bright red apices and branchlets, coral pink to orange-pink branches, presence of abortive branchlets, clampless septa and small spores. All these characters are shared by the two Australian collections listed above. In var. *stuntzii*, however, while the stipe flesh may be firmly gelatinous at the very base, it is not so upward, nor is the branch flesh gelatinized. This significant difference separates var. *gelatinosa* from var. *stuntzii*.

Only three spores were seen from the two collections (three basidiomes) of var. *gelatinosa*, but in both varieties spores are produced only some distance from the branch tips. Because of the paucity of spores, no examination of ornamentation in aniline blue could be undertaken.

Three other taxa, *R. aenea* Petersen, *R. flavo-saponaria* Petersen and an unnamed species from Italy seem to comprise this taxonomic complex. Basidiomes of the first are bronze coloured, those of the second bright yellow, and those of the third pallid orange-yellow. *Ramaria aenea* shows no hyphal agglutination, while *R. flavo-saponaria* and the Italian taxon exhibit a slippery (but not overtly gelatinous) consistency, and agglutinated tramal hyphae. All produce copious abortive branchlet clusters which remain without pigment where protected, indicating photo-induction of pigmentation. Also, unlike many brightly coloured members of the subgenus, *R. stuntzii* (with var. *gelatinosa*) retains its bright pink coloration after drying, making preliminary identification of herbarium specimens easy.

**7. *Ramaria subtilis* (Coker) Schild var. *microspora* Petersen & Watling, var. nov.** Fig. 1 D, E.

Basidiomata multiramiosi, ad 10 × 5 cm, crassi-sphaeropedunculati. Basi ad 3 × 2 cm, singulati, cum 1–2 ramuli abortivi; contusi brunnescenti; caro albo, non-gelatinoso. Rami deorsum citrino-flavi, ramuli superne croceoflavi. Apices tenui, croceoflavi. Hyphae contextualis afibulatae, crassi- ad tenuitunicatae. Basidia 50–60 µm longa, clavata, afibulata. Sporae 8.6–10.8 × 4.0–4.7 µm, ellipsoidae, subcorrugatae. (Watling 14825, holo. E).

*Basidiomes* (Fig. 1D) to 10 × 5 cm, broadly sphaeropedunculate. *Stipe* to 3 × 2 cm, discrete, with 1–2 abortive branch systems low on stipe, smooth, off-white, apparently brunnescent where handled or in age; *flesh* solid, white, not gelatinous or slippery. *Major branches* 3, hardly terete, lemon chrome. *Branches* in 3–6 ranks, ascending, terete, chrome yellow; *axils* rounded to lunate;

*internodes* diminishing gradually upward. *Apices* finely divided, cuspidate to minutely double-dichotomous, canary yellow. *Odour* and *taste* not recorded.

*Macrochemical reactions*: not recorded.

*Stipe tramal hyphae* 4–18  $\mu\text{m}$  diam., hyaline, thin- to thick-walled (wall to 1  $\mu\text{m}$  thick, often locally as torulose bands), clampless, interwoven, not adherent or agglutinated; ampulliform septa to 16  $\mu\text{m}$  broad, alliform, not unusually thick-walled, with extensive but delicate stalactitiform ornamentation; gloeoplerous hyphae not observed. *Tramal hyphae of upper branches* 2–15  $\mu\text{m}$  diam., hyaline, thin-walled, clampless, parallel, not adherent; ampulliform septa to 14  $\mu\text{m}$  broad, alliform, symmetrical, thin-walled without ornamentation; gloeoplerous hyphae common, 1.5–2.5  $\mu\text{m}$  diam., as undelimited lengths, refringent, often branched or anastomosed. *Subhymenium* rudimentary. *Hymenium* thickening; *basidia* 50–60  $\times$  9–10  $\mu\text{m}$ , clavate, clampless, weakly cyanophilous; contents homogeneous to minutely multivacuolate; sterigmata 4, spindly, straight, ephemeral. *Spores* (Fig. 1E) 8.6–10.8  $\times$  4–4.7  $\mu\text{m}$  ( $E = 2.00$ –2.55;  $E^m = 2.25$ ;  $L^m = 9.52 \mu\text{m}$ ), narrowly ellipsoid, subtly but obviously roughened in profile; contents homogeneous or uniguttulate, the guttule dark, subrefringent, discrete; wall up to 0.2  $\mu\text{m}$  thick; hilar appendix curved, not prominent; ornamentation of many small, flat warts and occasional short ridges randomly oriented.

*Habitat*: on slope with wet sclerophyll scrub of *Eucalyptus viminalis* and *E. robertsonii*, with *Acacia melanoxylon* and *Olearia lirata* understorey (ACT), and previously burnt-over area in dry sclerophyll forest, with *E. obliqua* and *E. radiata* (Victoria).

*Specimens examined*: AUSTRALIAN CAPITAL TERRITORY: Tidbinbilla Nat. Res., 26 iv 1974, Watling 10671 (E). VICTORIA: Gembrook, Melbourne, 11 v 1982, Watling 14825 (holo. E).

This variety shares with the type variety, described from North Carolina, basidiome stature, brunnescent bruising, yellow coloration (although apparently paler and less vivid) and clampless septa. The only significant difference between the type variety and the Australian taxon seems to be spore dimensions (for *R. subtilis*  $L^m = > 12 \mu\text{m}$ ) and roughness (spores of var. *subtilis* are not as rough as those of var. *microspora*). Variety *microspora* also resembles *Ramaria anziana* (see above) in basidiome stature and spore dimensions, but the colour of the basidiome is more apricot-colour, never the vivid yellow reported above. Moreover, no abortive branch systems are to be seen in *R. anziana*.

Petersen's (1982) redescription of Coker's type specimen (*Clavaria flava* var. *subtilis*) raised questions about the basidiome colour. Later (Petersen, 1986b), additional information was furnished on the species, and subsequently, several more recent collections at NCU have been examined (by RHP), together with photographs which show occasional abortive branch systems, identical to those seen in Watling 14825. Instead of crowded, cauliflower-like clusters (as in *R. magnipes* Marr & Stuntz), those of *R. subtilis* are elongated just as the major portion of the basidiome, but of only 1–3 dichotomies, arising scattered and low on the stipe. Notes with these specimens also confirms brunnescent bruising reactions (Petersen, 1982).

It should be noted that the combination *R. subtilis* (basionym: *Clavaria flava* var. *subtilis* Coker) was first proposed by Schild (1982). Later, Petersen (1986b) made the same proposal, ignorant of Schild's publication. Taxonomically, Schild's concept of *R. subtilis* is open to some question, but nomenclaturally his combination has precedence.

**8. *Ramaria versatilis* (Quélet) Petersen var. *latispora* Petersen in Sydowia 40 (1987): 220 (1988).**

*Basidiomes* to 14 × 6.5 cm, sphaeropedunculate to geniculate-sphaeropedunculate. *Stipe* up to 3 × 2 cm, discrete (sometimes caespitose in 2's or 3's), often with a tangle of slender, fragile, white rhizomorphs at base, often somewhat bulbous at base, rounded or gnarled below, smooth, off-white where protected, dull lavender drab above; *flesh* solid, off-white, not gelatinous or slippery. *Major branches* few, ascending, terete, concolorous with branches. *Branches* in 3–7 ranks, ascending, dichotomous above, terete, bright lavender ('deep dull lavender,' *teste* Fawcett), to dull lavender ('vinaceous drab,' 'dark vinaceous drab'), becoming more tan with spore production; *axils* rounded; *internodes* diminishing gradually upward. *Apices* finely divided, double-dichotomous, ruddy tan ('sorghum brown,' 'army brown') to ochraceous (*teste* Watling). All parts slowly brunescent ('cinnamon buff,' 'clay colour') where bruised. *Odour* and *taste* not recorded.

*Macrochemical reactions*: FCL, GUA +; KOH + 'Etruscan red,' 'testaceous' on purple surfaces; ANO, ANW, PYR, IKI–.

*Stipe tramal hyphae* 3–1 µm diam., thin- to thick-walled (wall to 1 µm thick), hyaline clamped, loosely interwoven, not adherent or agglutinated; ampulliform septa up to 13 µm broad, thick-walled (wall up to 1.5 µm thick), asymmetrical, with stalactitiform ornamentation; gloeoplerous hyphae not observed. *Tramal hyphae of upper branches* 3–1 µm diam., hyaline, thin-walled, clamped, parallel, not adherent; ampulliform septa up to 13 µm broad, asymmetrical, thick-walled (wall up to 0.5 µm thick), without ornamentation; gloeoplerous hyphae not observed. *Subhymenium* extensive; hyphae 1.5–2 µm diam., hyaline, clamped, thin-walled, tightly interwoven to pseudoparenchymatous. *Hymenium* thickening; *basidia* 62–70 × 9–10 µm, clavate, clamped; contents multiguttulate to multigranular at maturity; sterigmata 4, stout, curved. *Spores* 9.4–12.2(–13.0) × 5.0–6.5 µm ( $E=1.56$ – $2.25$ ;  $E^m=1.86$ ;  $L^m=10.67$  µm;  $W^m=5.78$  µm), ellipsoid, conspicuously roughened in profile; contents deep ochraceous, often with one dark, discrete guttule; wall to 0.3 µm thick; hilar appendix curved, prominent; ornamentation of large scattered warts and some lobate ridges.

*Habitat*: edge of gully, with *Cyathea* and *Dicksonia* in wet sclerophyll forest, with *Pteridium*, *Xanthorrhoea* and mixed eucalypts (ACT), and previously burnt-over area in dry sclerophyll scrub, with *Eucalyptus obliqua* and *E. radiata* (Victoria).

*Specimens examined*: AUSTRALIAN CAPITAL TERRITORY: Blue Range Block, Cotter Dam, 25 iv 1974, Watling (E). VICTORIA: Gembrook, Melbourne, 11 v 1982, Watling (E); Brisbane Mountain Range, Beremboke, 18 vi 1977, G. Weste [Petersen VIC5] (no. 47328, TENN, holotype); road to Yea, 12 vi 1977, Weste & Swart [Petersen VIC13] (no. 47317, TENN).

Until recently, sufficient material had not been examined to convince us that the spores of Australian material were consistently wider than those of the species as previously understood. Collections from Australia by both authors and examination of many collections of *R. versatilis* from Europe and North America (Petersen, 1988a) have now confirmed the differences and support Fawcett's comments on the situation in her account of *Clavaria fennica* Karst. (Fawcett, 1939). Accordingly, a new variety has been recognized for the Australian material.

**9. *Ramaria watlingii* Petersen, sp. nov.** Fig. 2 A, B.

Basidiomata multiramiosi, ad  $13 \times 10$  cm, sphaeropedunculati. Basi ad  $3 \times 1.5$  cm, singulati, cum ramuli abortivi; caro albo, non-gelatinoso. Rami et ramuli straminei ad pallide ochracei. Apices crassi, cum ramuli concolori. Hyphae contextualis fibulatae, crassi- ad tenuitunicatae. Basidia  $80-90 \mu\text{m}$  long, clavata, fibulata. Sporae  $9.7-12.2 \times 4.7-5.4 \mu\text{m}$ , cylindricae ad ellipsoidae, subcorrugatae. (Watling 14844, holo. E).

*Basidiomes* (Fig. 2A) to  $13 \times 10$  cm, sphaeropedunculate. *Stipe* up to  $3 \times 1.5$  cm, discrete, with abortive branchlets scattered over upper stipe, tomentose and white below, upward pale cream-colour; *flesh* solid, white, not gelatinous or slippery. *Major branches* several, hardly terete, somewhat divergent. *Branches* in 3-6 ranks, often flattened somewhat, commonly connate, dark straw yellow to pale ochraceous; *flesh* off-white, solid; *axils* broadly rounded; *internodes* diminishing gradually upward. *Apices* bluntly rounded, broadly digitate, often subcornute, concolorous with branches. *Odour* and *taste* not recorded.

*Macrochemical reactions* not recorded.

*Stipe tramal hyphae*  $5-24 \mu\text{m}$  diam., hyaline, thin- to thick-walled (wall locally to  $1 \mu\text{m}$  thick), interwoven, not adherent or agglutinated, commonly clamped; ampulliform inflations not limited to septa, thick-walled (wall to  $1 \mu\text{m}$  thick), with extensive stalactitiform ornamentation; gloeoplerous hyphae not observed. *Tramal hyphae of upper branches*  $3-8 \mu\text{m}$  diam., hyaline, conspicuously clamped, thin- to thick-walled (wall locally to  $1 \mu\text{m}$  thick), parallel, not adherent. *Subhymenium* extensive; hyphae  $2-3.5 \mu\text{m}$  diam., hyaline, conspicuously clamped, thin-walled, tightly interwoven. *Hymenium* thickening; *basidia*  $80-90 \times 10-11 \mu\text{m}$ , clavate, conspicuously clamped; contents homogeneous, weakly cyanophilous; sterigmata 4, straight, apical. *Spores* (Fig. 2B)  $9.7-12.2 \times 4.7-5.4 \mu\text{m}$  ( $E = 1.93-2.54$ ;  $E^m = 2.26$ ;  $L^m = 11.20 \mu\text{m}$ ), cylindrical to ellipsoid, conspicuously roughened in profile; contents 1-several-guttulate, the guttules dark, refringent, discrete; wall to  $0.3 \mu\text{m}$  thick; hilar appendix prominent, truncate; ornamentation of scattered, relatively large, flat warts often extended into short, unoriented ridges.

*Habitat*: Dry sclerophyll forest with thorny understorey, and mainly *Eucalyptus obliqua* and *E. radiata* (Victoria).

Specimen examined: VICTORIA: Gembrook, Melbourne, 11 v 1982, Watling 14844 (holo. E).

There are suggestions of brunnescence on the lowest branches and upper stipe of the sole basidiome of the collection, but this appears to be the result of advanced age or bacterial action, rather than a bruising reaction. Nonetheless, the following should serve as diagnostic for the taxon: the straw yellow colour of the basidiome; presence of clamped basidia; abortive branchlets on the stipe; and conspicuously roughened spores with  $L^m > 11 \mu\text{m}$ . This combination of characters is not known for any species recorded from New Zealand or appearing in the key to series *Flavo-brunnescentes* in Corner (1970).

*Stipe stature* (presence of abortive branchlets on the discrete stipe) is reminiscent of *R. magnipes* Marr & Stuntz and similar taxa, but they are clamppless, and have much stouter stipes. *R. watlingii* differs from *R. flavo-brunnesceus* (Atk.) Corner in the presence of abortive branchlets and conspicuously roughened, wider spores, and from *Ramaria flava* (Schaeff.: Fr.) Quélet in the presence of clamp connections, and larger spores. None of the above comparable species are known from Australasia.





FIG. 2. *Ramaria watlingii*: A, Basidiome; B, spores. *R. xanthosperma* var. *australiana*: C, spores. A, B from Watling 14844; C from Watling 14841. Scale (for spores only) = 5  $\mu$ m.

**10. *Ramaria xanthosperma* (Peck) Corner var. *australiana* Petersen & Watling, var. nov. Fig. 2C.**

*Basidiomata* multiramiosi, ad  $10 \times 6$  cm, crassi-ovati ad crassi-obpyriformi. Basi ad  $2 \times 1$  cm, singulati, cum ramuli abortivi, deorsum rubescenti; caro albo, non-gelatinoso. Rami deorsum cremei, ramuli superne cremei ad pallido-flavi. Apices tenui, sulphurei. Hyphae contextualis afibulatae, crassi- ad tenuitunicatae. Basidia  $60\text{--}65\mu\text{m}$  longa, clavata, afibulata. Sporae  $11.2\text{--}14.8 \times 4.3\text{--}5.8\mu\text{m}$ , boletoidae, subcorrugatae. (Watling 14841, holo. E).

*Basidiomes* up to  $10 \times 6$  cm, spherical to depressed-spherical. *Stipe* up to  $2 \times 1$  cm, small, sharply tapered to a rounded base, with some clusters of abortive branchlets low on stipe, pruinose between substratum pebbles and there white or off-white, naturally stained carmine or plum-coloured (*teste* Watling); *flesh* white, solid, not gelatinous or slippery, suffused red from surface stains. *Major branches* several, curved-ascending, hardly terete, cream coloured to ivory. *Branches* in 3–7 ranks, curved-ascending, more terete upward, concolorous with branches; *axils* narrowly rounded; *internodes* diminishing upward. *Apices* finely divided, minutely double-dichotomous, minutely awl-shaped, in age sometimes expanding into palmate or mitten-shaped forms reminiscent of *R. capitata*, sulphur yellow. *Taste* and *odour* not recorded.

*Macrochemical reactions*: not recorded.

*Stipe tramal hyphae*  $3\text{--}15\mu\text{m}$  diam., hyaline, thin- to thick-walled (wall locally to  $1\mu\text{m}$  thick), clamppless, interwoven, not adherent or agglutinated; ampulliform septa up to  $14\mu\text{m}$  broad, alliform, thick-walled (wall to  $1.5\mu\text{m}$  thick), with extensive stalactitiform ornamentation; gloeoplerous hyphae as cudgel-shaped lengths delimited at wide end by septum, but not delimited otherwise, and as subrefrinct, strongly cyanophilous, tortuous hyphae  $3\text{--}4\mu\text{m}$  diam. *Tramal hyphae of upper branches*  $3\text{--}10\mu\text{m}$  diam., hyaline, thin-walled, clamppless, parallel outward, interwoven inward, not adherent inward, perhaps adherent outward; ampulliform septa not observed; gloeoplerous hyphae as in stipe. *Subhymenium* extensive; hyphae  $1.5\text{--}2.5\mu\text{m}$  diam., clamppless, tightly interwoven. *Hymenium* thickening; *basidia*  $60\text{--}65 \times 10\text{--}12\mu\text{m}$ , clavate, clamppless, persistent after spore discharge; contents homogeneous when immature, minutely granular at maturity; sterigmata 4, very slender, straight, peripheral. *Sporae* (Fig. 2C)  $11.2\text{--}14.8 \times 4.3\text{--}5.8\mu\text{m}$  ( $E = 2.27\text{--}2.85$ ;  $E^m = 2.52$ ;  $L^m = 12.18\mu\text{m}$ ), subfusiform, often with suprahilar inflation, obscurely roughened in profile; contents 1–several-guttulate, the guttules dark, subrefrinct, discrete; wall to  $0.3\mu\text{m}$  thick; hilar appendix curved, not prominent; ornamentation of small, flat warts and/or narrow ridges generally oriented longitudinally.

*Habitat*: Edge of gully with wet sclerophyll forest (*Cyathea* and *Dicksonia*) (ACT), and previously burnt-over area in dry sclerophyll forest, or with mixed understorey in dry sclerophyll forest, and overstorey of *Eucalyptus obliqua* and *E. radiata* (Victoria).

*Specimens examined*: AUSTRALIAN CAPITAL TERRITORY: Blue Range Block, Cotter Dam, 25 iv 1974, Watling 10572 (E). VICTORIA, Gembrook, Melbourne, 11 v 1982, Watling 14841 (holo. E); Olinda, Melbourne, 12 v 1982, Watling 14793 (E).

*Basidiomes* of *R. xanthosperma*, commonly collected in eastern North America, differ from the Australian material only in spore dimensions (spores from var. *xanthosperma*  $11.5\text{--}14.8 \times 3.7\text{--}5.2\mu\text{m}$ ;  $E = 2.57\text{--}3.36$ ;  $E^m = 3.00$ ;

$L^m = 13.3\mu\text{m}$ ). Presumably, this taxon was treated by Fawcett (1939) under *Clavaria sanguinea*.

Only a few taxa are similar to the newly proposed variety. *Ramaria rubiginosa* Marr & Stuntz, from western North America, has smaller spores ( $8.5\text{--}11 \times 3.7\text{--}4.4\mu\text{m}$ ), and basidiomes of *R. rubri-attenuipes* Petersen & Zang, from interior China, exhibit an attenuate, rooting base. Spores of the latter are similar to those of *R. xanthosperma* (for *R. rubri-attenuipes*  $11.9\text{--}15.8 \times 4.7\text{--}5.4\mu\text{m}$ ;  $E^m = 2.69$ ;  $L^m = 13.4\mu\text{m}$ ).

#### A NOTE ON RAMARIA AUSTRALIANA

**Ramaria australiana** (Cleb.) Petersen in Bull. Torrey Bot. Club 96: 459 (1969). Syn.: *Clavaria australiana* Cleland in Trans. Roy. Soc. S. Australia 55: 159 (1931).

Holotype: South Australia, Mt Lofty, 9 vii 1927, Cleland 15968 (ADW).

It has been many years since notes on Cleland's type specimens were published (Petersen, 1969), and in that time additional experience with *Ramaria* from other parts of the world has been gained. It is important to draw attention to the fact that *Ramaria australiana* (Cleb.) Pet. is the only member of subg. *Ramaria* (characterized by spores with striate ornamentation) not to produce clamped septa on tramal hyphae and basidia (but see Taxon 2 below).

From the colours furnished by Cleland on specimen notes and labels, it would appear that two taxa may have been involved in the circumscription of *R. australiana*. Some colours ('vinaceous fawn,' 'vinaceous buff,' 'avellaneous,' with apices 'fawn [colour]') describe dull lavender shades. Others ('vinaceous russet,' 'vinaceous pink,' 'buff pink,' with apices 'Japan rose') are much more vivid pink to rose. The latter colours for example could be ascribed to *R. rubrievanescens* Marr & Stuntz. Fawcett (1939) cited colours as 'cinnamon buff' when young, with apices 'vinaceous'. In age, however, the purple shades became more distinct, so by maturity the upper branches were between 'hydrangea red' and 'dark vinaceous,' and finally upper parts became brownish (probably with spore production), masking the purple shades. To the same organism she also attributed picric yellow staining where bruised on the stipe, a reaction not mentioned by Cleland.

The specimens which reinforce separation of at least two taxa include Cleland 15976 (ADW) with colours as 'mostly 'vinaceous buff' . . . tips near 'fawn color,'' which shows clamped septa and striate spores  $11.4\text{--}12.8 \times 4.6\text{--}5.7\mu\text{m}$ , somewhat stubbier than those of *R. australiana* (type specimen:  $11.9\text{--}16.1 \times 3.6\text{--}5.5\mu\text{m}$ ). Specimens of this taxon are listed below under Taxon 1.

Likewise, a third taxon with striate spores seems sheltered under *R. australiana*. While showing clamped septa, its spores are shorter ( $8.9\text{--}10.7\text{--}(12.1) \times 4.6\text{--}5.7\mu\text{m}$ ) than those of *R. australiana*. Of the specimens one of us (RHP) has seen, no adequate colour notes are available. On Ferris 7151 (MELU), there appears, 'cream below, pink tips,' and other colours noted elsewhere are 'light ochraceous buff' and 'light ochraceous salmon'. Specimens are listed under Taxon 2 below.

Fawcett placed *R. australiana* in synonymy under *Clavaria rufescens* Schaeff.: Fr., which she also equated with *C. (Ramaria) holorubella* Atkinson, following

Coker (1923), as she did elsewhere. But she specifically stated (of her Australian taxon): 'Stem rooting, distinct, stout, smooth, whitish . . .' and, 'In age, the entire plant, with the exception of the base, takes on a brownish color . . .' Both *R. rufescens* and *R. holorubella* exhibit clamped basidia and it is the stipe base which first suffuses with burgundy color, later possibly spreading or appearing apically. Neither of the clampless Australian taxa can be equated with either *R. rufescens* or *R. holorubella* (see Petersen, 1986b, for modern description), and the third (with clamped septa) is not rubescent.

Habitat notes with Watling 10503 include: wet sclerophyll forest, with understorey of *Dicksonia*, *Olearia agrophylla*, *Bedfordia salicina* and overstorey of *Pomaderris aspera*, *Eucalyptus fastigiata* (Brown barrel) and *E. viminalis*.

Specimens examined (*R. australiana*): AUSTRALIAN CAPITAL TERRITORY: Tidbinbilla Reserve, 27 iv 1974, Watling 10503 (E). SOUTH AUSTRALIA: East Torrens, Basket Range and Norton Summit, 22 vi 1977, Talbot [Petersen SA42] (TENN); Mt Lofty, 25 iv 1924, Cleland 15969 (ADW); Mt Lofty, 8 vi 1931, Cleland 15971 (ADW); Mt Lofty, 23 vi 1928, Cleland 15970 (ADW); National Park, 20 vi 1931, Cleland 15975 (ADW); Encounter Bay area, v 1939, Cleland 16023 (ADW). VICTORIA: road to Yea, 12 vi 1977, Weste & Swart [Petersen VIC6, 41225] (TENN); Brisbane Mt Range, Beremboke, 18 vi 1977, Weste [Petersen VIC12] (TENN).

*Ramaria* taxon 1. SOUTH AUSTRALIA: Willunga Hill, 23 v 31, Cleland 15976 (ADW); Willunga Hill, 29 v 1933, Cleland, s.n. [ADW-'light pinkish cinnamon.' Tips 'light vinaceous cinnamon.' Flesh reddish in section. Main branches becoming buffy.] (as *C. australiana*); Willunga hill, 29 v 1933, Cleland 15977 (ADW-as *C. australiana*); Stirling, iv 1946, Cleland 8263 (ADW).

*Ramaria* taxon 2. SOUTH AUSTRALIA: Aldgate, 25 iv 1946, Cleland 16106 (ADW); Echunga, 12 vi 1939, Cleland 16019 (ADW). VICTORIA: Wangaralta, iv 1956, M. Ferris 7151 (MELU).

#### REFERENCES

- BERKELEY, M. J. (1873). Australian fungi received from Baron F. von Mueller and Dr R. Schomburgk. *J. Linn. Soc.* 13: 155-177.
- COKER, W. C. H. (1923). *The Clavarias of the United States and Canada*. 209 pp, Chapel Hill.
- CORNER, E. J. H. (1970). Supplement to 'A monograph of Clavaria and allied genera'. *Beih. Nova Hedwigia* 33: 299 pp.
- (1986). The genus *Clavulina* (Basidiomycetes) in southeastern Australia. *Austral. J. Bot.* 34: 104-105.
- DOTY, M. S. (1944). *Clavaria, the species known from Oregon and the Pacific Northwest*. Oregon State College, Corvallis. 91 pp.
- FAWCETT, S. G. M. (1938). Studies on the Australian Clavariaceae. Part I. *Proc. Roy. Soc. Victoria*, n.s. 51: 1-10.
- (1939). Studies on the Australian Clavariaceae. Part II. *Ibid.* 51: 265-280.
- KORNERUP, A. & WANSCHER, J. H. (1967). *Methuen Handbook of Colour*. London. 248 pp.
- LLOYD, C. G. (1922). *Clavaria capitata* from E. J. Semmens, Australia. *Mycol. Notes* 7: 1107.
- MARR, C. D. (1968). *Ramaria of western Washington*. PhD thesis, University of Washington.
- & STUNTZ, D. E. (1973). *Ramaria* in western Washington. *Biblioth. Mycol.* 38: 232 pp.

- PETERSEN, R. H. (1969). Type studies in the clavarioid fungi. III. The taxa described by J. B. Cleland. *Bull. Torrey Bot. Club* 96: 457-466.
- (1978a). The genus *Clavaria* in south-eastern Australia. *Austral. J. Bot.* 26: 415-424.
- (1978b). The genus *Ramariopsis* in south-eastern Australia. *Ibid.* 26: 425-431.
- (1978c). Type studies in the clavarioid fungi. V. A few Australasian taxa. *Mycotaxon* 7: 386-392.
- (1979). Notes on clavarioid fungi. XVII. *Clavulinopsis* taxa in southeastern Australia. *Sydowia* 32: 209-223.
- (1982). Contribution toward a monograph of *Ramaria*. V. Type specimen studies of taxa described by W. C. Coker. *Sydowia* 35: 176-205.
- (1983). The genus *Clavulina* in southeastern Australia. *Nova Hedwigia* 37: 19-35.
- (1986a). Response to E. J. H. Corner. *Austral. J. Bot.* 34: 105-106.
- (1986b). *Ramaria* taxa from Nova Scotia. *Canad. J. Bot.* 64: 1786-1811.
- (1988a). Contribution toward a monograph of *Ramaria*. IX. The *R. fennica*—*R. versatilis* complex. *Sydowia* 40 (1987): 197-226.
- (1988b). *The Clavarioid Fungi of New Zealand*. *DSIR [New Zealand] Bull.* 236: 170 pp.
- RIDGWAY, R. (1912). *Color Standards and Color nomenclature*. Washington, D.C. 43 p+53 pls.
- SCHILD, E. (1982). *Ramaria*-Studien. *Zeitschr. Mykol.* 48: 117-128.