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STUDIES IN THE AGARICS OF DENMARK

BY

JAKOB E. LANGE

PART VI

PSALLIOTA RUSSULA

KØBENHAVN
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With a colour-chart.

THE GENUS PSALLIOTA.

Although *Psalliota* is an almost over-illustrated genus — the figures of *P. campestris, P. arvensis* etc. being almost legion — like most other genera it cannot be said to be well-illustrated. The smaller species in particular (which lack interest from a culinary point of view) are just as incompletely and inaccurately illustrated in this genus as in most other genera; and even for some of the rarer forms of the bigger »mushrooms« the same holds true. I have tried in »DANMARKS AGARICACEER« to meet this want*).

The multitude of unreliable pictures and the often defective or inaccurate descriptions — more than the real difficulties in distinguishing the species — confound the student of this genus and often leave him bewildered as in a maze, without assistance of any kind. And although the species, as met with in nature, appear to be rather constant and distinct, and should not present any insurmountable difficulties to the trained eye, the synonymy even of some of the large and conspicuous species is often of a rather labyrinthine character.

*) »*Danmarks Agaricaceer*« now numbers 970 watercolour-plates, all painted by the author. (Library of the Bot. Museum of the University, Copenhagen). For further particulars see part I of these Studies.

I cannot hope altogether to disentangle such Gordian knots; but my figures may serve to give coming students of the genus a fairly reliable and clear impression of what species are really to be met with, a synoptic view, so to speak, which should be an important preliminary to any further study of the subject and which cannot be had in any other way because some of the species are so rare that specimens may be sought for in vain for decades (and preserved material can give no clear and vivid impression of the characteristics of the living plants).

Psalliota is a well-defined genus which stands in a rather isolated position. Some few *Stropharias* (more especially *S. coronilla*) have a superficial likeness. And some *Lepiotas* have by mistake been placed in the genus. Even Fries himself thus misplaced *Lepiota echinata* (*hæmatosperma*) on account of its subfuscous sporepowder. And some authors, e. g. Cooke (loc. cit tab. 524) have done the same to *Lep. naucina* (sub nom. *Psalliota cretacea*) on account of its gills at last becoming somewhat reddish.

The microscopic examination of the several species confirms the impression given by their outward appearance that *Psalliota* is a very natural and homogeneous genus. The spores are almost uniform: broadly oval or ovate (somewhat oblique or subphaseoliform), generally with a large central oil-drop, quite smooth. They vary somewhat in size, but within rather narrow limits (average length 5 to 10 μ). The size of the spore appears to me on the whole to be a fairly constant character and therefore useful for the taxonomy of the genus. The fleshy species (»*Edules*« Fr.) have generally comparatively large spores, »*Minores*« Fr. considerably smaller. Two-spored basidia are rare; I have only met with them in one of the numerous forms of the *hortensis*-group.

In most species the edge of the gills is densely set with sterile cells (cystidia?). They are not much differentiated: clavate (more or less capitate) to obovate. In *P. perrara* and *P. villatica* they are somewhat septate or formed of 2—3 oblong cells. Only some few species (*P. campestris* sensu restr.) and *P. comtula* are entirely destitute of marginal cystidia. (F. H. Møller informs me that he has detected, in specimens of P. camp. some few scattered and small sterile marginal cells).

The number of described species and varieties is very great.

Yet one often feels strongly tempted to coin new names, when none of the existing diagnoses exactly fit the case. Still I have as a rule prefered to use the existing names and stretch the description a little — in order not to increase the *embarras de richesse* in names.

It is rather difficult to find any leading characteristics which naturally divide the genus in groups of species. FRIES himself divided the *Psalliotas* in two lots: *Edules* and *Minores* (»in cibariis rejectis, pileo tenuiter carnoso«), evidently a rather unscientific distinction, but still not altogether misleading. Others (e. g. KAUFFMAN loc. cit.) divide in *Bivelares* and *Univelares*, placing such species as *P. arvensis* in the former section on account of the texture of the veil, which besides the membranaceous inner tissue consists of a thicker outer one which generally splits up when the cap expands, either radially or into numerous cottony patches or squamules. Although this feature is very marked in some species I hesitate to use it as a leading sectional character. In certain cases the outer tissue is very defective or almost obsolete in types which in all other respects are close to true bivelate species (thus f. inst. the slender form »*P. silvicola*« which is next in kind to *P. arvensis*). In other cases bivelate forms occur in univelate series (f. inst. var. *subfloccosa* in the *P. hortensis*-tribe). To take the presence or absence of a double veil as the decisive test of relationship leads to questionable innovations such as the transferring of *P. hortensis, cryptarum* etc. to *P. arvensis* (REA).

The colour of the gills seems to be a very constant and reliable character (vide for instance the pallid-gilled series: *P. augusta* — *P. arvensis* — *P. silvicola* — *P. dulcidula* etc., in which the young gills are almost white, changing slowly to pallid or to very pale flesh-colour, while other species (*perrara* — *hæmorrhoidaria* — *campestris*) already when the »bud« opens have pure rosy flesh-coloured gills). But colours which change from day to day or almost from hour to hour are rather difficult to describe to others with sufficient precision.

Probably the best and most exact distinctive features are those shown by the microscope, more especially the presence or absence of marginal cystidia and their varying shape. Also the size of the spores may be profitably used as a leading distinction; it seems to be rather constant and is comparatively

easily ascertained, even if it requires fairly accurate measuring, because the difference is rather slight in certain cases.

The number of species (and varieties) figured in »DANMARKS AGARICACEER« is 14. This I believe to be a fairly complete representation of the genus (SEV. PETERSEN (loc. cit.) only mentions 9 species in all, while RICKEN has 11 species for Central Europe).

KEY

TO THE SPECIES FIGURED OF THE GENUS PSALLIOTA.

A. **Megasporæ.** Spores $> 6^1/_2 \times 4\ \mu$ (Fleshy, rather large fungi).

α. Imbricatæ. Cap densely clad with ochraceous-brown or fulvous, fibrillose scales. Rather tall species (Stem higher than diam. of cap).

a. Gills pinkish-incarnate.

1. Stem squarrose when young; flesh whitish. (Very large plant) ..... 1. *P. perrara.*
2. Stem almost smooth; flesh cherry-red—pinkish when cut (medium-sized plant) ..... 2. *P. hæmorrhoidaria.*

b. Gills pallid (no trace of pinkish). (Very large plant) .. 3. *P. augusta.*

β. Sublævigatæ. Cap almost smooth, fibrillose, whitish or subfuscous to brown (rarely somewhat imbricate, but then short-stemmed.)

a. Gills whitish, then slightly flesh-coloured. Skin whitish, yellow to the touch.

1. Robust, short-stemmed, very large. Spores 9—11 μ l. 4. *P. villatica.*
2. Rather tall, medium-sized. Spores $< 8\ \mu$ long.
   * Ring double; outer ring radiately split ..... 5 a. *P. arvensis*
   ** Outer ring obsolete. Stem slender with flattened basal bulb ..... 5 b. *P. a. silvicola.*

b. Gills flesh-coloured or pink. Stem short (shorter than diameter of cap). Skin not turning yellow.

1. Cystidia present (Cap dingy greyish to brown).
   * Basidia 2-spored..... 6 a. *P. hortensis bispora.*
   ** Basidia 4-spored.
      † Veil subperonate, forming belts on stem. Cap brownish, squamose..... 6 b. *P. h. subperonata.*
      †† Ring double; outer ring very narrow, radiately split. Cap dingy greyish with scattered, white, cottony flocci near margin..... 6 c. *P. h. subfloccosa.*
2. Cystidia absent. Cap white ..... 7. *P. campestris.*

B. **Microsporæ.** Spores $< 6 \times 4\ \mu$. (Small or at least but slightly fleshy species).

α. Subsquamosæ. Cap rather large (6—10 cm), coated with a dense tomentum of brown fibrils, which later form imbricate scales. Young flesh red to flesh-colour when cut .... 8. *P. sanguinaria.*

β. Sublævigatæ. Cap small, almost smooth or minutely fibrillose.

a. Cystidia present. (Gills not pinkish).

1. Cap convex, 4—7 cm.

* Cap whitish, in the middle becoming more or less vinous-fuscous from minute fibrils ..... 9. *P. rubella.*

** Cap densely clad with innate, fuscous-crimson fibrils ..... 10. *P. amethystina.*

2. Cap umbonate, very small (3 cm) whitish ..... 11. *P. dulcidula.*

b. Cystidia absent. Gills light pinkish. Cap whitish, almost smooth ..... 12. *P. comtula.*

SYSTEMATIC AND FLORISTIC NOTES.

A. MEGASPORÆ.

1. **Psalliota perrara** Schulz (= *Bresadolæ* Schulz).

Spores ovate, $7^1/_2 \times 5—5^1/_2$ μ. Cystidia on edge of gills cylindric, often somewhat septate or formed of 2—3 oblong cells.

Fig. specimen (DANMARKS AGARICACEER plate 642): Hunderup, in frondose wood, solitary under Quercus, Sept. 1903 (Also June 1900, in the same wood).

This imposing and beautiful species appears to have tempted a number of name-givers, and its synonymy accordingly is very intricate. The various descriptions do not agree in details, but probably they all refer to the same species. The best and most complete diagnosis is that recently given by FERDINANDSEN & WINGE (Meddelelser f. For. til Svampekundskabens Fremme 1924. 2). SCHULZ himself does not mention the floccose scales on the lower surface of the ring and says the cap is »dilute ochraceus«. REA (loc. cit.) says the scales on the ring are fulvous, and so they are in RICKEN's and BRESADOLA's figures (loci. cit.) which depict a rather medium-sized mushroom. Except for the somewhat smaller spores *P. peronata* Massee is exactly like small specimens of my plant. And to judge from the very brief description in MASSEE: European Fungus Flora *P. prænitens* Beck must be identical and so undoubtedly is *P. subrufescens* Peck (ex KAUFFMAN, loc. cit. plate 48—50).

The most prominent characteristics of this species are: the extraordinary dimensions (stem about 15 cm × 3,5 cm), the white, squarrosely-scaly stem, the fulvous-brown fibrillose scales on the cap and the bright incarnate gills. The lower surface of the broad ring is set with brownish, rather large, floccose scales.

The flesh is whitish with a flush of flesh-colour, especially in the stem.

2. **P. hæmorrhoidaria** (Kalkbr.).

Spores ovate-oval, 8—9 × 4½—5 μ. Basidia 4-spored (1909). Gill's edge set with balloonshaped, 12—20 μ broad cystidia (1914—15)*).

Fig. specimens (D. A. 643), Hunderup, in mixed frondose wood (Quercus, Fagus, Corylus), Sept. 1899 (and in other similar localities, solitary or subgregarious, but not common).

A good many authors evidently mix up this species with another »bleeding« mushroom, the much more slender and thinner *P. sanguinaria* (or *P. silvatica*). They certainly have much in common, especially the fibrillose-scaly brown cap and the pinkish—cherry-red flesh (especially in the stem). But the young white stem of P. hæm. turns somewhat reddish (not yellowish) to the touch, the gills are bright flesh-coloured and the spores much larger than in *P. sanguinaria.*

3. **P. augusta** Fr.

Spores oval or ovate, 7—10 × 5—5½ μ. (7½—8½ × 4½—5¼ μ; cyst. 4-spored (1917)).

Fig. specimens (D. A. 639): Årup, »Kohave«, in wood of Picea, a number of specimens. Also found in similar locality near Ravnholt, 1917.

Very conspicuous on account of its gigantic stature and its whitish-ochraceous, minutely brown-scaly cap. The white stem is squarrosely scaly up to the ring when young, turning yellowish when touched. And the gills change from white to chocolate without at any time having any flush of flesh-colour.

P. augusta sensu Rick., with larger spores (12—14 μ long), a white cap and comparatively short stem is more like *P. villatica* (sensu Bres.), which he also mentions as very closely allied to *P. a.* (vide no: 4).

4. **P. villatica** Brond. (sens. Bresad.).

Spores ovate, 9—10 × 6 μ (9—11 × 6 μ 1915). Cystidia on edge of gills inflated, often formed of short rows of cells (like *Saccharomyces cerevisiæ.*

Fig. specim. (D. A. 641): Lundeborg, gregariously in an old grassfield, Aug. 1914 (and Tommerup, similar locality, Aug. 1915).

This species which is very well figured in BRESADOLA: *Fungi Tridentini,* is almost too close to *P. arvensis*, from larger and stouter specimens of which it can hardly be distinguished. And if no previous name existed I should prefer to call it simply *P. arvensis robusta.* Its most characteristic features are the short

*) Except where expressly stated otherwise the spore-measures and other microscopic details refer to the specimens figured.

and broad stem (which below the ring is somewhat squarrose), the ring which on the outside is floccosely scaly all over and the somewhat larger spores. — *P. augusta* sensu Rick. and *P. lepiotoides* Schulz are almost identical.

5. **P. arvensis** (Schaeff.)

Spores $6^1/_2$—$7 \times 4^1/_2$ μ (7—$7^1/_2 \times 4^1/_2$ (1914) (7×4 (1915). Marginal cystidia obovate or subspheric, 14—20 μ broad.

Fig. specim. (D. A. 640): Ø. Åby, grassy bank along road, Oct. 1896, and Hjallese, under shrubs in grass, Oct. 1916. Common especially in shady places and woodland, more especially in old plantations of Picea, not rarely forming »fairy-rings«.

The typical *P. arvensis* stands in a central position in a group of species characterised by pallid to pale flesh-coloured gills and a more or less conspicuous exterior ring which — when the cap expands — splits radially or in all directions, while the interior, membranaceous ring remains entire. The stem is somewhat hollow, but the narrow cavity is more or less stuffed with arachnoid or cottony tissue. In all the forms the skin turns yellow to the touch. The extreme on one side of this group is the gigantic and scaly *P. augusta*; then comes the robust *P. villatica* and on the other side we have the slender *P. silvicola*, the small *P. rubella* and the pigmean *P. dulcidula*.

P. (arvensis var.) silvicola Fr.

Not figured. — Spores $6^1/_2$—$7 \times 3^3/_4$—4 μ.

Fries makes this form a variety of *P. campestris*, probably because the exterior ring is often almost obsolete. But its slender stature, yellow-turning skin and very pale flesh-coloured gills naturally refer it to the neighbourhood of *P. arvensis*, from which it is only distinguished by being smaller and more slender (apex of stem generally about 1 cm thick), almost univelate and generally with a more distinct, flat, basal bulb.

Apparently *P. abruptibulba* Peck (KAUFFMAN, loc. cit. fig. 47) is identical.

[*P. cretacea* Fr. is a rather disputed species. RICKEN uses this name for the more robust form of *P. arvensis* (reserving the name *P. arvensis* for the more slender silvatic form which is here called *P. silvicola*). COOKE (loc. cit. Plate 942) figures a form of Lepiota naucina under this name, and REA (loc. cit.) makes short work of the problem by simply putting *P. cretacea=Lepiota naucina*. But this is directly against the description of Fries himself, who expressly states (in HYMENOMYC. EUROP.) that the spores of *P. cretacea* are like those of *P. campestris* and the gills »carneo- l. fusco-nigricantibus«. Probably it is merely a form of the *arvensis*-group which hardly deserves a specific name].

6. **P. hortensis** (Cooke) (extended by J. E. L.).

Under this name I unite a number of mushroom-forms which are generally ranged under *P. campestris*, but which differ from the true *P. campestris* (alba) by their sordid or brown cap and especially by having marginal clavate cystidia. They are all very thick-fleshy and generally short stemmed (stem shorter than diameter of cap) and their gills want the pure pink colour of *P. campestris*. None of them turn yellow when touched.

6a. **P. h.** *bispora* J. E. L.

Spores broadly ovate, $6^1/_2$—$7^1/_2 \times 5$—$5^1/_2$ μ. Basidia 2-spored. Cystidia broadly clavate, 8—12 μ broad above.

Fig. specimens (D. A. plate 646): Odense, on heap of road-scrapings (soil and gravel mixed with horse-droppings). Oct. 1906. The cap in this form is sordid-brownish, somewhat fibrillose-tomentose, but hardly squamose. The flesh is extraordinarily thick, slightly rufescent in the stem, and the ring is thin and spreading, slightly thickened towards the margin.

(According to several modern authors (e. g. A. A. PEARSON) the cultivated mushroom almost invariably is 2-spored).

6b. **P. h.** *subperonata* J. E. L.

Spores 7—$7^1/_2 \times 5$—$5^1/_2$ μ. Basidia 4-spored. Cystidia clavate, slender 35 × 8 μ.

Fig. specim. (D. A. plate 645): Pederstrup, gregariously outside an inn-stable, on naked soil, Sept. 1905 (and in diverse villa-gardens, park-drives etc. on naked rich soil, 1914—15 etc.).

This form is characterized by the somewhat imbricately fibrillose-scaly cap; the scales are dull brown, rather large, innate and adpressed. The ring is narrow, often almost double, divided horizontally by a circumcisal rent; when the stem elongates the lower part of the veil is separated from the upper, thus forming a kind of belt or short sheath below the ring. — *P. Rodmani* Peck appears to be identical (vide KAUFFMAN loc. cit. 234 et plate).

6c. **P. h.** *subfloccosa* J. E. L. (= var. *albo-squamosa* W. G. Smith (?)).

Spores $6^1/_2 \times 4^3/_4$ μ. Cystidia cylindric-clubshaped. Basidia 4-spored.

Fig. specim. (D. A. plate 647): Hollufgård, forming large fairy-rings on naked ground in plantation of Picea, Aug. 1915.

Surface of cap smooth, tomentose-fibrillose, pale sordid, slightly fawn-coloured in the middle, almost whitish towards the margin. The broad inner ring close to the stem is coated with a narrow, radiately split outer ring (somewhat after the manner of *P. arvensis*). Near the margin of the cap are often seen scattered, white, cottony scales, which probably are

remnants of the same outer veil. The flesh is more coloured than in the other forms (light flesh-coloured in the cap, rubescent in the stem). — It may deserve specific rank.

7. **P. campestris** (L.) sensu restr. J. E. L. (= var. *alba* Berk.).

Spores somewhat obliquely ovate, 7—8 × 4½—5½ μ. Basidia 4-spored. Marginal cystidia 0.

Fig. specim. (D. A. plate 644): Hjallese, grassy roadside along wood. Sept. 1899. Rather common on old lawns, village-greens, along hedges, occasionally in fairy-rings of large dimensions.

I have segregated this type from the above-named forms 6 a—c principally on account of its want of cystidia; but it also differs from them in many other ways. Its chief characteristics are the white, somewhat silky-fibrillose cap, the narrow, somewhat cottony ring, and the pure pinkish gills without the dingy whitish edging (from the cystidia) which characterizes *P. hortensis*. While *P. hortensis* grows in rich soil (rubbish-heaps, stable-yards etc.) this is a typical inhabitant of grassy commons, sheep-runs etc.

B. MICROSPORÆ.

8. **P. sanguinaria** Karst. (*P. silvatica* (Schaeff.) sensu Rick. nec Bres.).

Spores 5—6 × 3—3½ μ. Basidia 4-spored. Edge of gills set with inflated clubshaped cystidia, which are 8—11 μ broad above.

Fig. specim. (D. A. plate 648): Pederstrup, in great numbers in dense plantation of Picea on humid ground with old stumps of Alnus. Not uncommon in similar localities.

As mentioned under no: 2 this species is often not clearly distinguished by the mycological authors from P. hæmorrhoidaria with which it certainly has much in common. It differs however from *P. h.* by its much more slender stature (the stem is midway about 1 cm thick, while in P. h. it often attains 2 cm), more dull-coloured gills and smaller spores. The flesh of the cap is rather thin (midway about 6 mm). The surface is formed by a dense, fibrillose or felty, brown or pale fawn-coloured coating which at first is almost smooth but later, as the cap expands, becomes more or less imbricate-scaly (even if the scales are often neither so distinct nor so dark fuscous-umber, as in the specimens figured). The horizontal and somewhat radiately striate ring is whitish at first, but soon becomes sordid. Its edge it slightly thickened. Like *P. hæmorr.* it has at first an almost white stem, the flesh of which turns quickly flesh-colour—cherry-red; but soon the stem (inside and outside) becomes sordid and at last fuscous. When young it turns somewhat yellowish to the touch.

Although the description of *P. sanguinaria* by KARSTEN is not altogether satisfactory, I prefer to use this name instead of the equivocal name *P. silvatica*. RICKEN's roughly sketched figure and good description of P. silv. certainly belongs here. But BRESADOLA's (loc. cit. I. Tab. 90) is entirely different; and MICHAEL (loc. cit.) as well as COOKE figure mushrooms under the name *P. silvatica* which are very much like *P. arvensis*.

9. **P. rubella** Gil. forma *pallens* J. E. L. (= *P. arvensis* var. *purpurascens* Cooke (?)).

Spores ovate, $5^1/_2 \times 3^1/_2$ µ. Cystidia on edge clavate, 6—7 µ broad.

Fig. specim. (D. A. 649): »Fruens Bøge«, under Picea in frondose wood, July 1915. (And at »Store Ernebjerg«, in mixed frondose wood, Aug. 1915).

Cap 4—$5^1/_2$ cm broad, at first almost pure white, minutely silky-fibrillose; later on the fibrils, especially in the central part of the cap, become sordid-purplish. The gills are at first pallid, then pale flesh-colour (no white edging). Stem white, rather slender (midway about 8 mm thick), below the ring fibrillose-floccose, base swelled to a roundish bulb. The ring is thin, expanded, simpel. The flesh of the cap is white, that of the stem somewhat ochraceous, and the skin turns yellow when touched.

This slender little mushroom is very much like a miniature of *P. arvensis silvicola*, but has much in common with *P. amethystina*. *P. rubella* in the sense of REA, with rosy-flesh-coloured gills and bleeding flesh, evidently belongs to the *sanguinaria*-tribe. — Probably the figure in COOKE's ILLUSTRATIONS of *P. arvensis* v. *purpurascens* depicts a rather large and rich-coloured form of the same plant. At any rate it is evident (to judge from the smallness of the spores — $4-5 \times 3$ µ ex Rea —) that it belongs to *Microsporæ* and cannot be a form of *P. arvensis*.

Gillet's own figure (loc. cit. tab. 102) is very good and shows that what he in the text designates as »squames« are in fact minute squamules, and that a broad brim of the cap is almost pure white. It is a fairly good representation of my plant, except the young specimen in bud which is reddish all over.

10. **P. amethystina** Quél. (= *P. semota* sensu Rick.).

Spores broadly ovate, $5 \times 3^1/_2$ µ. Basidia 4-spored. Edge of gills with small obovate sterile cells.

Fig. specim. (D.A.650) Hesselager, »Nye Have«, rather numerous on the ground in dense wood of Picea, Oct. 1909. (Rather rare).

This pretty little species is well characterized by its purplish colour. I add a brief description: Cap convex, at last almost flat, 2—5 cm, densely clad with silky, innate fibrils, which are dark brownish-crimson. (The central part is darker and slightly squamose-fibrillose). Under the fibrils the skin is at first pallid flesh-colour, becoming darker with age. The gills are

crowded, at first pallid-greyish, then darker brownish-fuscous with a pale edge. The stem is 3—6 cm high, 3—4 mm thick, somewhat swollen below and often somewhat curved, pallid, often (especially when touched) turning yellowish, at last sordid; it has a narrow cavity and its ring is expanded, horizontal, thin, white: The flesh is white, in the stem somewhat yellowish.

P. semota Fr. (sensu Rick.).

comes very close to my *P. amethystina* but is somewhat larger and paler (a transition to *P. rubella*). But Fries' own description of *P. semota* is rather different (»Pileo .... lævi, glabro .... disco umbrino« etc.); vide his figure in ICONES SELECTÆ.

11. **P. dulcidula** Schulz.

Spores broadly ovate 5 × 3½ μ. Basidia 4-spored. Sterile cells obovate-spheric, about 10 μ broad.

Fig. specim. (D. A. plate 652): Erholm, near Årup, solitary in wood of Fagus and Picea, Sept. 1913.

Cap only 3 cm broad, conic-convex, then expanding and somewhat umbonate, umbo comparatively fleshy. The fundamental colour of the cap is white (slightly brownish in the middle), but it is everywhere (rather sparsely) set with minute, innate, silky, dark purplish-brown fibrils (especially in the centre). The gills are narrow (2 mm), pallid grey, with a slight flush of brown. The stem is 4—5 cm × 2 mm (base swollen to about 5 mm), slightly fibrillose-squamulose, whitish, (yellow to the touch) with yellowish flesh and a rather narrow, thin ring. — The smallest of our Psalliotas, well characterized by the umbonate cap. — *P. minima* Rick. differs in having broad, ventricose gills.

12. **P. comtula** Fr.

Spores subspheric-oval, 4½—5 × 3—3¼ μ. (1900). 5—5½ × 3—3½ μ; cystidia 0. Basidia 4-spored (1905).

Fig. specim. (D. A). plate 651), Kollund near Flensborg, grassy common near the seaside, Sept. 1900. Also met with on coast-common near Kerteminde, Sept. 05 and at Vissenbjerg, Sept. 05 etc.

Very much like a miniature *P. campestris* (*alba*). Superficially it bears some likeness to *Stropharia coronilla* (pale specimens). The want of cystidia characterizes this species, microscopically. The light flesh-coloured gills distinguish it from the preceding small species.

Besides the species described above some few others are recorded. Thus SEV. PETERSEN (loc. cit.) mentions *P. pratensis* (Schaef.) from meadows near the coast of the North Sea, and a form of *P. sagata* (var. *foetens* Sev. P.) from Bromme near Sorø.

THE GENUS RUSSULA.

It is not without strong hesitation that I step on to the »pons asinorum« of mycology: the taxonomy of the genus *Russula*. Vestigia terrent! The synonymy of the innumerable species is very bewildering and the use of the microscope — which in many cases puts the modern mycologist in a comparatively good position — in this genus gives very little assistance of real value. The chemical tests which are used by some modern *Russula*-students I have had no opportunity of putting in to practice.

Nevertheless I hope that my brief notes on the different species will be of some use in clearing up some of the intricate problems met with, especially when used together with my illustrations, which of course are my chief contribution to the study of the genus.

The fact is that I have — during the last 30 years — illustrated with pencil and brush if not all at least the overwhelming majority of the European species.

I have portrayed in all 62 species (or distinct varieties); and even such modern authors as Rea (loc. cit.), has only 66 for Great Britain; Ricken enumerates 45 (loc. cit.), and Bataille in his monograph mentions 72 European species, a good many of which are evidently known to him only from descriptions and probably identical with other species).

Now nothing is more bewildering to the clear conception of a species than the host of figures by different artists (often not themselves mycologists) which, if not flatly contradictory are at least inaccurate and more or less incorrectly coloured. But when making use of a collection of figures executed all by the same hand

(and by the mycologist himself) one is protected from such mistakes. The figures in my collection cannot of course claim absolute perfection, but they will, so to speak, be defective all in the same way; the artist's manners of depicting gills, striation etc. is always the same, and one does not run the risk of meeting a number of figures depicting under various names what in reality are only specimens of the same species, rendered in different styles by different artists — or conversely: depicting the same species in different ways, thus giving the student a wrong impression of variability, while in fact most species within this genus are rather constant in most respects.

As mentioned above I look upon my watercolours as by far my most important contribution to the study of this genus. In fact I think it will be possible by means of these portraits nearly always to identify any species met with, at least for mycologists with fairly well trained eyes and some knowledge of the leading types. — But the Key which I have arranged and the brief descriptions given below will, I hope, further facilitate the study of this interesting genus. The critical or disputed species I have treated somewhat more thoroughly, still without entering into all those minute details which make some modern descriptions fill up several pages. A really good figure will spare many words.

In arranging my »Key« I should have liked to uphold the old Friesian taxonomical groups, as most innovations — if not strictly indispensable — are of questionable value. But personal experience has taught me that it is very difficult — at least for the beginner — to get a clear conception of most of these sections, to make out whether a species belongs f. inst. to *Furcatæ* or *Heterophyllæ*. Even Fries himself placed such intimate relatives as *Russula Quéletii* and *R. sardonia* (ɔ: *expallens*) in different groups. I therefore choose other tracks which — although perhaps not so scientifically correct — are easier to find.

While upholding the first Friesian section *Compactæ* (as all authors do) I lump all the others in one large main group which I call *Genuinæ* or the true Russulas, nearly all characterized by bright colours.

The genuine Russulas I primarily divide in two sections: *Leucosporæ* and *Xanthosporæ*. I do not think fit to go so far as

SCHROETER (loc. cit.) who segregates the yellow-spored species as a distinct genus, *Russulina*. The boundary-line is hardly distinct enough for that, and many intimately related species will be separated by doing so. But as a main sectional character the colour of the sporepowder is certainly very useful. Other authors have used the mild or acrid taste as the chief mark of distinction for the main divisions; but this — to say the least — appears to me less practical: While the colour of the sporepowder can always be ascertained, the acrid taste sometimes disappears with age. And while the particular spore-colour seems to be constant (or almost so) in any species, tasteless and acrid forms of what in all other respects are identical species appear to be not uncommon (at least if divers authors can be trusted).

The line of demarcation between Leucosporæ and Xanthosporæ as mentioned above is not very precise. Besides the pure white or clear ochraceous sporepowder found in most species, creamy and custard-yellowish colours occur (e. g. in R. sanguinea, R. graminicolor, R. purpurea, R. graveolens). These intermediates I place in the yellow-spored or white-spored group chiefly according to their affinity to other species.

Leucosporæ and *Xanthosporæ* are then each divided into two large sections, according to the colour of the cap; *rubentes* and *versicolores*. The former comprises all species with any kind of red colour (from blood-red to pale lilac flesh-colour), the latter all the rest. In general I find the colour of a *Russula* — and particularly the presence or absence of red — to be a fairly reliable specific character. Of course here as elsewhere albinos do occur (f. inst. of *R. fragilis* and *R. lepida*). And in some cases the red colour fades away rather early (specimens of *R. chamæleontina* which are pink when young often become ochraceous with age, because the fundamental ochre is constant, the red not). But when a species is designated as »omnicolorous (as f. inst. *R. integra* by Fries) to my mind it is in reality a collective species, which when properly investigated will dissolve itself into a series of species. Even in such cases where the red colour is almost absent traces of it will generally remain. Thus in *R. olivacea* — which is in fact simply a *R. alutacea* with the crimson left out — the apex of the stem, just below the gills, is slightly pink, while in the type the red is

much more pronounced and often extends downward over a large portion of the stem. A rather unique colour-variation occurs in *R. violeipes—amoena*. When quite young the cap is (always?) pure pale sulphur, because the »meal« on the surface is colourless, but grandually the contents of the meal-cells turn violet-purplish, thus obscuring the sulphur colour and giving the surface more or less pronounced dull olivaceous or even violaceous tints and shades. Only in one instance do I deviate from the strict adherence to the *rubentes-versicolores* division: Some of the forms of *R. cyanoxantha* and its allies are distinctly reddish or flesh-coloured, but I place them in *versicolores* on account of their close affinity to *R. heterophylla*).

Besides the colour of the cuticle the colour of the flesh is in some cases very characteristic. Within the section *Compactæ* rubescent or nigrescent decolorations are very well known. But also some of the *Genuinæ* show similar although less pronounced decolorations of the flesh in age or when exposed to the air. Already Fries mentions that the flesh (of the stem in particular) in certain species turns grey with age (*R. decolorans, R, ochroleuca* etc.). This decoloration, however, is somewhat dependent on the weather, being much more conspicuous in wet weather than in dry seasons. Not so another decoloration, met with in *R. graveolens, R. purpurea* and others. In these species the originally white flesh (and also the gills) turns dirty ochraceous-brownish when cut or bruised (like certain kinds of summer-apples). As this decoloration seems to be very constant, it can be profitably used for identification.

A serious obstacle to the use of colour as a prominent factor of the diagnoses is the unpreciseness of the colour-terms. Many commonly used terms are quite equivocal, e. g. ashy grey, clay-brown, terra cotta etc. And even such simple terms as ochre, brown, yellow are often used in a somewhat different sense by the individual authors. These difficulties are of course not lessened when the descriptions are in different languages. Thus f. inst. purple in English often indicates a deep violet (*Clematis Jackmanni*), more rarely a deep bloodred-crimson (purple beet), while in Latin it is often used to designate a dull crimson (*Lamium purpureum*) and in Danish not rarely as a synonym to blood-red. »Kræm« in Danish does not mean the colour of cream but that of custard; and »chestnut-brown« to a

Danish reader conveys the idea of »brown like the horse-chestnut«, while to a Spaniard it probably means »brown as an edible chestnut.« Other colour-terms have no exact synonyms in the different languages. Thus »gilvous«, »tawny« or »tan« in English and »gredelin« in Swedish have no exactly corresponding terms in Danish.

Now, when my »*Studies*« are used together with my *illustrations* the exact meaning of my colour-terms can easily be ascertained. But as my drawings are not always at hand I have added to the present part of my »Studies« a colour-chart with some 120 colours (especially such dingy and mixed tints as are common in the Agarics) which I hope will come useful to the student and prevent misunderstandings.

Within *Leucosporæ* Rubentes and Versicolores are next divided according to their taste. (In the yellow-spored series acrid species are very few and do not form natural groups). This character must be used with some caution. The acrid taste sometimes disappears with age, and in some species it requires rather lengthy mastication to bring it out. All parts of the fungus (gills, flesh and cuticle) should be tried. It is to me rather questionable whether want of taste suffices for separating a species from another, similar in all other respects. I should prefer in such cases to retain the tasteless form as a variety.

For the characterization of the minor groups and the individual species various structural details of almost any part of the fructification are made use of.

1) *Size.* — Within the genus Russula the size of the fructification appears to be comparatively constant. It is rather rare to meet with specimens varying outside the range of 2 : 1 in diameter. I therefore do not hesitate to use size as a rather prominent character.

2) *Form.* The form of the cap varies but little in this genus. Most species when in bud are subglobose, flattened above or slightly depressed. Some few (*decolorans*) are distinctly globular, while others (*delica*) on the contrary are deeply depressed in the centre before pushing through the soil (and therefore lift it almost like a mole). The form of the stem also varies within rather narrow limits. In *Compactæ* it is nearly always short and stout; within *genuinæ* some few species are rather tall and slender (*decolorans*, *puellaris*) while such species as *vinosa*, *aurata*

and *lutea* are shortstemmed; but this character seems to be rather inconstant, varying according to the habitat (dry and exposed or humid and sheltered). The outline of the stem is generally slightly conical, occasionally somewhat ventricose or even subfusiform; but these variations are rarely distinct enough to be of great value for the identification of the species.

3) *Cuticle.* While in Compactæ the tissue of the cap is so homogeneous that a distinct pellicle is almost wanting, in Genuinæ it is generally well defined. And the looser the tissue of the cap the more distinct the pellicle. Thus in the Friesian group Fragiles it can be peeled off (generally from the edge half way in or more), while in the group Rigidæ it is firmly adnate. In most Genuinæ it is more or less viscid, but this character must be used very cautiously, as it depends very much on the state of the weather. Some few species are characterized by their rough or granulate epiderm. Thus in *R. virescens* the outer stratum of the cuticle is ruptured all over into small granulate areolæ, and *R. cutefracta* shows the same feature in a less marked way. *R. violeipes* has the cuticle of the cap (and the stem) thinly covered by a »bloom« of colourless or violet meal, and *R. azurea*, when examined under a lens, presents a similar but very inconspicuous white »bloom«.

In most species the edge of the cap is more or less striate or sulcate. This character chiefly depends upon the thickness of the flesh. When the flesh is thin near the margin so that the gills are covered almost only by the cuticle, the edge naturally becomes sulcate, showing the underlying gills (like the ribs in the chest of a lean horse). If the gills in such species be connected by transversal veins the margin becomes tubercular-sulcate. But very much depends upon the age of the specimen: even quite smooth-edged species will become somewhat sulcate with age, at least when they begin to wither. This character must therefore be used with considerable caution.

The surface of the stem is rarely absolutely smooth and even; in most cases it is slightly rugose-venose, but in some few species these veins are more conspicuous, forming a kind of network of low ridges on the entire surface (*R. purpurea* etc.). The somewhat powdery surface of the stem of *R. violeipes* is mentioned above.

4) *Flesh.* As indicated by the Danish name »Skørhat«

(Brittlecap) the flesh in the Russulas is more brittle than in the ordinary Agarics, on account of the great number of subglobular cells in the tissue. But while some species within *Genuinæ* (like the *Compactæ*) are rather firm and compact (f. inst. *R. virescens, R. lepida, R. violeipes*) others (*puellaris, chamæleontina, nitida* etc.) have rather soft and spongy flesh especially in the stem, which in many cases even becomes hollow with age. Some few species (*R. foetens* and its allies) have the stem hollow from the beginning (generally a number of distinct cavities, one above the other). The characteristic decolorations of the flesh are mentioned above.

The »mild« species are generally almost tasteless. But the »acrid« taste varies considerably from species to species and can be very characteristic. Thus some few species (e. g. *R. solaris*) have a pure and rather agreeable mustard-seed taste (and smell), while in the majority it is more pungent or even somewhat bitter (*R. fellea*). In a few almost insipid species (e. g. *R. pseudointegra*) prolonged mastication will produce a faint bitterish (but not acrid) taste.

The smell also affords good specific characters. Really strong-smelling species are rare. The characteristic stench of *R. foetens* is known by every mushroom-hunter; a faint smell of the same character is present in other species within the same tribe (e. g. *R. livescens*). Another slight but characteristic smell (almost like crab) is met with in *R. graveolens* Romell, but not always perceptible before the fructification is somewhat over-ripe. The smell of dry or decaying specimens I do not take any note of.

5) *Gills.* The density of the gills is very variable; the extremes are met with in *Compactæ*, where *R. nigricans* has very distant, thick and waxy gills while in *R. densifolia* they are rather crowded and thin. When comparing two species in this respect they must however be in the same stage of development, as the gills are of course much denser when the cap is young and only partly expanded. — In some species (*R. delica, R. albonigra* and other *Compactæ* and *R. sanguinea*) the gills are distinctly attenuato-decurrent. In others they become spuriously decurrent when the cap with age becomes strongly depressed or infundibuliform. But in most species they are rounded behind, slightly adnexed or almost free. In many cases they are broadest in front and rounded, thus making the edge of the cap

rather obtuse; more rarely they are narrow and rather acute in front (*sanguinea* etc.). In *Compactæ* they generally are unequal ɔ: long and short ones alternating. But most *Genuinæ* have very few short gills or none at all (*R. integra* etc.). In some cases the gills are »basifurcate« ɔ: united two and two behind (*R. basifurcata* etc.); and where short gills are present they are often united behind with the neighbouring main gill, (spuriously furcate). None of these characters however are very distinct and conspicuous.

In some cases the gills in wet weather are densely beaded with drops of water. (*R. expallens*, *R. luteotacta*, *R. delica* etc.). This apparently is a distinct character, but rather difficult to use in the diagnoses, as it depends too much on the state of the weather.

The colour of the gills depends partly on the colour of the tissue of the gill itself and partly on the colour of the spores. The fundamental colour is generally white (pale sulphur in *R. expallens*), but in some cases alters with age (like flesh and stem) into dingy white or pale greyish (pale amber in *R. puellaris*). In some species (*violeipes*, *alutacea*, *aurata* etc.) the edge, especially in front, is coloured after the manner of the cuticle. Even the deep yellow-spored species have almost white gills when beginning to open; but as the spores begin to ripen, the yellow tinge becomes more pronounced and often at last quite »butter-yellow«. But in other species it never goes beyond a pale cream-yellow or »whitemaize«.

In order properly to estimate the colour of the spores they should be allowed to fall on glass-slides. If collected on black or (still worse) on blue paper (as recommended by some authors) the colour may be somewhat misjudged by contrast-effect (Cream will look more yellow on blue). And on white paper the sporepowder will look of a purer white if the paper be slightly cream and vice versa. But a slide of glass can be placed on any background desired. The colour, at all events, must be described while the sporepowder is quite fresh.

6) *Microscopical characteristics.*

Spores. — The size and form of the spore only varies within narrow limits. They are generally broadly ovate to subglobose, long diameter 6—10 μ. In the blackening species of *Compactæ* they are almost smooth, but all the rest have distinctly rough spores. Without the use of immersion-objectives the

details of the configuration of the spore cannot be clearly seen; and as most species have only been investigated by me — especially in earlier years — by means of lower-power objectives I do not give for this genus spore-figures of all the species, as in the preceding parts of these Studies, because unsatisfactory figures can be more misleading than elucidating. Most species have warty or warty-prickly spores; but in some cases the warts are more or less confluent, thus forming ridges which make the surface of the spore more or less reticulate. (BEARDSLEE, loc. cit. figures a number of such subreticulate species, f. inst. *R. aurata* and *foetens*). As far as I can see such reticulation is however neither so distinct nor so common in this genus as in *Lactarius*. The spinulosity of the spores evidently comes useful for their distribution by insects and slugs, to whose skin they stick like the pollen of insect-fertilized flowers.

Cystidia. The edge of the gills is generally (always?) set with cystidia, occasionally also their face. They are generally rather uniform: the free portion more or less acutely subulate or conical, the entire cystidium elongated fusiform. In a good many species somewhat similar cystidiiform cells are met with on the surface of the cap. The cuticle is chiefly made up of slender, filiform hyphæ (2—$2^1/_2$—3 μ in diameter); but while in some species these hyphæ are the sole elements of the tissue, f. inst. *R. heterophylla*, *R. lepida*, *R. purpurea* and *R. ochroleuca*), in the majority of the species examined by me coarser, subfusiform cells (average diameter 5—$7^1/_2$ μ) are also present, in some cases in great numbers. Their form is generally clavate-fusiform, and the content of the cell is often somewhat partitioned (after the manner of an unripe ascus of a Peziza), but genuinely septate cystidia with transversal partitional membranes I have never seen. In some cases these »cystidia« are fairly distinct from the filiform hyphæ (e. g. in *R. azurea, R. simillima, R. fellea, R. fragilis, R. fallax, R. vinosa*); but in others all kinds of intermediates are met with (f. inst. in *R. chamæleontina, R. foetens, R. alutacea, R. mollis*). Some modern mycological authors attach much systematic value to these cystidia or oleiferous cells; but although I have not yet been able to form any definite opinion I am under the impression that their importance can easily be overestimated. At any rate the existence of intermediate cell-

forms makes the distinction between cystide-bearing and cystideless species less clear.

Minor details will be mentioned in the descriptions of the several species.

KEY

TO THE SPECIES FIGURED OF THE GENUS RUSSULA.

I. **Compactæ** (Fries).

(Flesh compact, firm. Edge of cap incurved. No distinct pellicle. Gills unequal. All species whitish or sordid).

A. ADUSTÆ. Flesh turning sootbrown or black. Spores almost smooth.
- α. Gills very distant, very thick ..... 1. *R. nigricans*
- β. Gills rather crowded, thinner.
  1. Flesh (in young specimens) slowly becoming rubescent when cut ..... 2. *R. densifolia.*
  2. Flesh not becoming reddish.
     - a. Cap sordid, turning slowly blackish or soot-gray when old 3. *R. adusta.*
     - b. Cap white, rapidly turning pitch-black when touched or bruised ..... 4. *R. albo-nigra.*

B. CONSTANTES. Flesh not turning grey or black. Spores warty-spinulose.
- α. Spores and gills very pale cream-yellow ..... 5. *R. pseudo-delica.*
- β. Spores white. Gills white (or slightly greenish)..... 6. *R. delica.*

II. **Genuinæ** (J. E. L).

(Flesh less compact, thin towards margin. Edge of cap but slightly incurved. Short gills few or none. Cap generally bright-coloured. Spores warty or spinulose).

A. LEUCOSPORÆ. Sporepowder white (rarely slightly cream).

- α. *Rubentes.* Cap red or reddish (deep bloodred, scarlet, pink or pale lilac flesh-colour).
  1. Acerrimæ. Flesh very acrid.
     - a. Stem flushed with red or purple.
       - * Cap purple.
         - † Young gills pale sulphur, beaded with drops. 7. *R. expallens.*
         - †† Young gills white, not beaded ..... 8. *R. Queletii.*
       - ⁂ Cap scarlet-pink ..... 9. *R. sanguinea.*
     - b. Stem white.
       - * Cap scarlet-pink.
         - † All parts spotted with chrome-yellow when bruised..... 10. *R. luteotacta.*
         - †† Not spotted with yellow.
           - • Cap medium or rather large, scarlet to bloodred-pink ..... 11. *R. emetica.*
           - ⁝ Cap rather small (3—7 cm), bright pink ... 12. *R. fragilis.*

⁂ Cap not scarlet or pink (either deep purple or dingy purplish).
† Cap rather small (4—5 cm), edge tubercular-sulcate ..... 13. *R. fallax.*
†† Cap very small (2—3 cm), edge almost even .. 14. *R. serotina.*

2. Insipidæ. Flesh almost tasteless.
a. Stem flushed with red or purple.
* Stem flushed with purple, Cap sulphur, with tinges of purple or olive ..... vide *R. violeipes.* (no: 28).
⁂ Stem flushed with pink. Cap pinkish scarlet or dark blood-red.
† Cap dark blood-red, flesh dingy ochre-brownish when cut ..... vide *R. purpurea* (no: 42).
†† Cap scarlet, pink or pale rosy.
° Cap very large, scarlet-pink ..... 15. *R. Linnœi.*
°° Cap rather large, pink to pale rosy ..... 16. *R. lepida.*
b. Stem not flushed with red or purple.
* Cap dark dull blood-red, very large. Vide *R. atropurpurea* (no: 41).
** Not so.
† Cap pure pink; stem powdery-granulose ..... 17. *R. rosea.*
†† Cap dingy lilac, flesh-coloured or purple.
° Flesh of stem white, not turning sordid or yellow with age.
§ Cuticle of Cap ruptured in all directions near the edge ..... vide *R. cutefracta* (no: 30).
§§ Cuticle entire.
› Rather large and fleshy, edge almost smooth.
× Cap pallid lilac flesh-colour or sordid purplish-olive. Gills covered at the edge ..... vide *R. cyanoxantha* (no: 31).
⁂ Cap pale hazel flesh-colour. Gills uncovered (for about 1-2mm) at the edge .. vide *R. vesca* (no: 35).
» Rather small; flesh thin; edge striate-tuberculate.
× Cap lilac-pinkish; Stem slightly tinged with same colour ..... 18. *R. lilacea.*
⁂ Cap pale flesh-colour; stem entirely white ..... 19. *R. carnicolor.*
°° Flesh of stem turning sordid or yellow with age (in wet weather)
§ Medium. Stem turning sordid-brownish or greyish.
› Cap vinous-purple, fading whitish ... 20. *R. vinosa.*
» Cap fading to yellowish-alutaceous from centre towards margin, which remains purplish ..... 21. *R. depallens.*
§§ Very small. Cap sordid-purple. Stem turning amber-yellowish with age vide *R. puellaris* (no: 50).

β. *Versicolores.* Cuticle not red or purple (rarely light lilac flesh-colour or purplish-olive).

1. Acerrimæ. Flesh very acrid (except in no. 24 and 26). All yellow or fuscous. (Vide also *R. fragilis alba*).
   a. Cap very large, brownish ochre, stinking ..... 22. *R. foetens.*
   b. Cap medium, inodorous or faint smelling.
      * Cap livid-fuscous with faint *foetens*-smell ..... 23. *R. livescens.*
      (Smaller (3—6 cm), paler, almost insipid) ... 24 *R. livescens var.*
      ** Cap yellowish or ochraceous.
         † Gills and stem (when young) white.
            ° Cap pallid ochre, margin sulcate, Gills beaded with drops. Intensely acrid ..... 25. *R. simillima.*
            °° Cap bright yellow-ochre, edge almost even. Flesh almost insipid ..... 26. *R. ochroleuca.*
            (Vide also *R. solaris* (no: 56).
         †† Gills and stem when young concolorous with the cap (but paler), whitish-gilvous. Very acrid .... 27. *R. fellea.*

2. Insipidæ. Flesh almost tasteless. (vide 24 and 26).
   a. Cuticle minutely powdered or granulate-areolate.
      * Cuticle (of cap and stem) as if powdered with minute hyaline or violet particles (fundamental colour pale sulphur) (vide also no: 37) ..... 28. *R. violeipes.*
      ⁂ Cuticle ruptured into granules or patches.
         † Flesh under cuticle not red, epiderm ruptured everywhere in small warty granules..... 29. *R. virescens.*
         †† Flesh under cuticle purplish red, epiderm only ruptured in irregular patches near the edge... 30. *R. cutefracta.*
   b. Cuticle not ruptured or granulate.
      * Rather large and firm-fleshy fungi, edge almost even.
         † Gills not becoming cream-yellow.
            ° Flesh under the cuticle reddish or purplish flesh-colour. Cap either pale lilac flesh-colour or dark olivaceous with flushes of purple. 31. *R. cyanoxantha.*
            °° Not reddish under the cuticle.
               § Gills covered at edge of cap; edge not beaded with drops.
                  › Cap coloured.
                     × Green or fuscous-olivaceous ... 32. *R. heterophylla.*
                     ⁂ Dingy-brown .....33. *R. mustellina (?).*
                     (Cap yellow: vide no: 26)
                  » Cap almost white ..... 34. *R. galochroa.*
               §§ Gills uncovered (1—2mm) at edge of cap, beaded with drops. Cuticle pallid brownish flesh-colour 35. *R. vesca.*
         †† Gills at last cream-yellow. Cap olivaceous, somewhat rubescent under the epiderm ..... 36. *R. olivascens.*
      ⁂ Cap smaller and thinner; flesh rather spongy.
         † Cap dull bluish-green or pigeon-blue with a faint bloom of whitish dust..... 37. *R. azurea.*

†† Cap without such bloom.
° Cap medium (or rather large), pallid (or bright) green. Gills somewhat cream, spotted fuscous when old ..... 38. *R. graminicolor.*
°° Cap very small (3 cm) almost white, greenish in centre. Gills unspotted ..... 39. *R. smaragdina.*

B. Xanthosporæ. Sporepowder yellow or distinctly yellowish (rarely creamy or white).

α. *Rubentes.* Cap more or less red (bloodred, pink, purplish, lilac).
1. Edge of gills chrome-yellow ..... 40. *R. aurata.*
2. Edge of gills not yellow.
a. Flesh when cut (or at least stem with age) turning ochre-brownish. Gills very pale yellowish (or white).
* Cap dark or bright bloodred.
† Stem not flushed with red. Sporepowder white 41. *R. atropurpurea.*
†† Stem flushed with red; sporepowder cream . 42. *R. purpurea.*
** Cap ochraceous-olive, reddish towards the edge 43. *R. graveolens.* Vide also *R. olivacens* (no: 36).
b. Flesh when cut not turning dirt-brownish.
* Stem more or less flushed with red, especially above.
† Fundamental colour pink to dull crimson, but more or less disguised by dusky olive..... 44. *R. alutacea.*
(No olive tinges)..... 44b. *R. a. var. rosella.*
†† Cuticle olivaceous (with a slight tinge of purple). 44a. *R. a. var. olivacea.*
** Stem with no trace of red.
† Large to medium.
° Cap rather large, deep purple with tinges of olive or pale ..... 45. *R. Romelli.*
°° Not so.
§ Cap rather large, bright rosy-scarlet 46. *R. pseudo-integra.*
§§ Cap not rosy-scarlet.
› Cap ochre in the middle, brick-red towards the margin; slowly acrid ..... 47. *R. substyptica.*
» Cap pale pink, fading to alutaceous ochre in the middle; almost tasteless ..... 48. *R. veternosa.*
†† Very small.
° Cap more or less purplish-pink, fading to pale ochre. Stem white. Gills bright yellow-ochre. 49. *R. chamæleontina.*
°° Cap dull purple (centre very dark). Stem becoming amber-yellow. Sporepowder cream-white 50. *R. puellaris.*

β. *Versicolores.* Cap greenish, yellow, brown or pallid.
1. Cap whitish-pale or somewhat olivaceous greenish.
a. Cap whitish-pale, large. Gills pale cream..... 51. *R. basifurcata.*

b. Cap pallid olivaceous-greenish, medium. Gills becoming light ochre ..... 52. *R. mollis.*
(Cap olivaceous, apex of stem flushed with pink: vide no: 44a).

2. Cap copper-brown to yellow.
a. Gills' edge clear chrome-yellow (vide no: 40).
b. Gills not edged with chrome-yellow.
* Cap dark purplish copper-brown, acrid ..... 53. *R. cuprea.*
(Cap dull date-brown: vide no: 49a).
** Cap Fulvous to pale yellow.
† Almost tasteless.
° Copperbrown-fulvous ..... 53. *R. integra.*
°° Fulvous-yellow to yellow.
§ Fulvous-yellow ..... 54a. *R. i. var. xanthophœa.*
§§ Pure yellow.
› Medium; edge striate ..... 54b. *R. i. var. lutea.*
» Small, edge almost even ..... 55. *R. lutea.*
†† Cap pale chrome-yellow, edge sulcate. Very acrid 56. *R. solaris.*

FLORISTIC AND SYSTEMATIC NOTES.

Although most of the important characters of the several species are mentioned in the Key, I think it will increase the usefulness of my »*Studies*« for the handling of this intricate genus if I give, in this place, a brief diagnosis of each species. — Even if a »Key« be very well constructed and one's eye fairly well trained, one can »go wrong« in tracing a species to the end of its labyrinthine trail. But in such cases the diagnosis of the species in question will at once make evident the mistake.

(Like all other parts of these »studies« the diagnoses are based entirely on personal observation, and do not give anything on authority).

Lengthy and detailed descriptions are beyond the scope of this work. A glance at the drawings will in most cases tell you more than half a page of letter press. But to give readers who have no access to my figures a fairly accurate impression of the colour of the *Russulas* I have added the above-mentioned colour-chart, to which references are made in the text whenever necessary for the clear conception of the colour-terms.

I. COMPACTÆ.

A. Adustæ.

1. **Russula nigricans** (Bull.) Fr.

Diagnosis: Very large; cap 7—15 cm*), depressed in the middle, whitish to dull soot-brown, soon becoming blackish. Gills very distant and very thick, pallid. Stem whitish, firm. Flesh thick, hard, persistent, at first whitish (rufescent when cut or bruised), but soon becoming gray. All parts blackening with age.

Microsc. characters: Spores subspheric, $6^1/_2$—7 × $5^1/_2$—6 μ**), somewhat verrucose. Cystidia on edge of gills inflated, up to 12 μ broad, generally obtuse, basidiiform or somewhat fusiform. Cuticle of cap made up of interwoven, brownish, 4—5 μ broad hyphæ (1917)***).

Figured specimens: »DANMARKS AGARICACEER«, pl. 860, Hjallese, wood of Fagus, Aug. 1897. — Very common, especially in frondose woods.

2. **R. densifolia** (Secr.) Gil.

Diag.: Large; cap. 6—10 cm, strongly depressed, edge deeply involute, in most cases dingy brown or bistre (at first often pallid), viscid. When young the pallid margin is slightly pruinose. Gills crowded, whitish, slightly rounded behind. Stem short, stout, whitish at first. Flesh at first whitish (and then rubescent (colour-plate d 7) when cut) but soon turning gray and at last becoming black (but not so hard as in no. 1).

Micr. char.: Spores ovate-spheric, somewhat verrucose, 7—8 × $6^1/_2$ μ. Cystidia on edge crowded, obtuse or acute fusiform. Cuticle of cap formed of interwoven 3—4 μ broad hyphæ (1920).

Fig. specim.: D. A. 861, Kajberg near Nyborg, wood of Fagus, July 1900, gregarious. — Rather common in similar localities.

3. **R. adusta** (Pers.) Fr. (*R. densifolia var.*?)

Diag.: Very large; cap 7—12 cm, strongly depressed, at first pallid or whitish, then dull dark gray (c 3—c 4). Gills truly decurrent, crowded. Stem stout. Flesh whitish, not turning reddish (or at least only very slightly so when the flesh is very young and succulent), soon becoming dull gray.

Spores almost spheric, $7^1/_2$ μ diam., somewhat verrucose.

Fig. specim.: D. A. 862. Hjallese, wood of Fagus, Aug. 1897.

It appears to me rather questionable whether nos: 2 and 3 can be clearly distinguished. My description almost equals that of Fries and Ricken; but neither of these authors knew R. densifolia.

*) ɔ: The diametre of the fully expanded cap.
**) Always exclusive the warts.
***) All the microscopic characters, when not expressly stated otherwise, are from the figured specimens.

4. **R. albo-nigra** (Krombh.) Rick.

Diag.: Rather large; cap 7—10 cm, depressed-infundibuliform, slightly viscid, milkwhite, very quickly blackening when touched and at last becoming pitch-black all over. Gills decurrent, crowded, white at first. Stem stout (not very short), firm (not eroded by grubs like *R. densifolia*). Flesh not rubescent, but quickly blackening.

Spores subspheric-oval, $7^1/_2 \times 6$ µ, indistinctly verrucose. Edge of gills set with scattered, subulate bristles.

Fig. specim.: D. A. 863. Ågård near Kolding, gregariously under Abies excelsa in wood of Fagus, Aug. 1920.

Bataille describes this characteristic species sub nom. *R. adusta*. Kauffman (*The Agaricaceæ of Michigan* pg. 129, plate XIV) sub nom. *R. sordida Peck* describes and figures a Russula which evidently is identical (the only difference is that the American plant is dry, while mine is slightly viscid). Fries' description (which refers to Krombholz' figure) is less adequate: Stem abnormally short, gills fuscous-whitish etc. — Ricken says the gills are »orangelich-weiss« whatever that means).

B. Constantes.

5. **R. pseudo-delica** J. E. Lange.

Diag.: Pileus crasse carnosus, 10—11 cm diam., e depresso infundibuliformis, albidus, centro pallide flavescense tincto. Lam. descendentes, ex albidis ochraceo-lacteæ, subconfertæ, simplices, postice leviter rotundatæ. Stipes crassus (2—3 cm), brevis, albus, subradicatus, firmus et solidus. Caro alba (in basi stipitem pallide cinerea), pungens. Sporæ (in cum.) ochraceo-pallidæ.

Very large: Cap about 10—11 cm, deeply depressed and, soon infundibuliform, slightly viscid when young, glabrous, whitish, with a flush of dingy yellowish (e5—k2) in the centre. Gills descending, slightly rounded behind, rather crowded, whitish at first, but soon ochraceous-custard-yellowish (e5—b7), not furcate. Stem stout (2—3 cm), rather short (4—5 cm), white, firm and solid. Flesh everywhere white except in base of stem where it is slightly sordid; taste pungent (not very strong). Spore-powder custard-ochraceous.

Spores spheric-oval, $7^1/_2$—$7^1/_4 \times 6^1/_4$—6 µ, warty-spinulose. Trama of gills formed of a tissue of spheric cells (12—25 µ diam), sparingly interwoven with 4 µ broad hyphæ, which here and there run out between the basidia to the surface of the gill. Basidia 4-spored, clavate, 60×9—10 µ. Cystidia on edge crowded, protruding part subulate, 30 µ long.

Fig. specim.: D. A. 859. Hollufgård, gregarious in wood of Fagus, Aug. 1917. — It has a superficial likeness to *Lactarius*

piperatus and also recalls Fries' figure of *R. semicrema* (which differs in having pure white gills and sordid-gray coloured flesh in the stem. It also comes near to *R. albidula* Peck (sensu Beardslee) (*Journal of the Elisha Mitchell scient. soc.* Vol. 33 no. 4); but while mine is a genuine *Compacta*, the American plant appears to belong to *Genuinæ*.

6. **R. delica** Fr. (= *R. chloroides* (Krombh.)).

Diag.: Very large; cap 7—15 cm, at first milkwhite, later becoming more alutaceous or dingy ochraceous, especially in exposed places, depressed in the middle from the very beginning (even before pushing through the soil), at last infundibuliform. Margin strongly incurved. Surface somewhat rough. Gills white, often with a slight tinge of sea-green (a 8) behind, decurrent, moderately distant (rather crowded in young specimens). Stem short and stout. Flesh hard, but brittle, almost tasteless.

Spores subspheric-oval, $8^1/_2$—$9^1/_2 \times 6^1/_2$—7 μ, coarsely warty. Cystidia (protruding part) about 30 μ, almost cylindric, slightly attenuated towards the blunt tip, about 7 μ broad.

Fig. specim.: D. A. 858. Hjallese, mouldy ground in mixed frondose wood, Sept. 1901. Very common in all kinds of wood.

I have tried in vain to distinguish two separate species (*chloroides* and *delica*) as done by Bresadola and others. The greenish tinge is often wanting in specimens which in all other respects are exactly like green-tinged ones. The rather small specimens figured by me are very much like Bresadola's *delica*, but show the greenish tinge said to characterize *chloroides*.

II. GENUINÆ.

A. Leucosporæ.

α. Rubentes.

1. Acerrimæ.

7. **R. expallens** Gil. (*R. sardonia* Rick. nec Bres.).

Diag.: Medium to large; cap 6—9 cm, convex, soon somewhat depressed, at first very dark purple (n 1—n 3) (centre almost black), quickly fading to purplish-lilac (n 8—n 7) (occasionally olive-greenish) and at last almost colourless. Gills (even when quite young) pale sulphur (l 1), crowded, beaded with drops, adnate to subdecurrent. Stem more or less flushed with purple or lilac (n 8) (paler than the cap), soon fading and at last somewhat livid-sordid. Flesh at first rather firm, wine-red under the cuticle, slightly yellowish, intensely acrid. Sporepowder cream-white.

Spores subspheric-oval, 7—7½ × 5½—6 μ, warty-spinulose.

Fig. specim.: D. A. 892, Langesø Nordskov, in a bog with Pinus and Betula etc., gregarious, Oct. 1919 (A) and 1923 (B). Also Gerup skov (Holstenshus), sloping ground towards Sphagnum-bog (under Betula and Pinus), but also where no Pinus-trees were to be found, Oct. 1925.

R. sardonia Ricken is identical and so is *R. Queletii* in MICHAEL: *Führer f. Pilzfreunde. R. sardonia* Fr. is a much disputed species. BRESADOLA uses this name for *R. luteotacta.* — ROMELL (*De genere Russula*) gives an excellent description of the present plant from the Friesian locality for *R. sardonia*, but evidently includes finds which belong to *R. Queletii* (»lamellæ . . . juniores .... fere albæ at siccæ«). — *R. drimeia* Cooke (*Illustrations* plate 1023) is very close, if not identical; the only real difference is the pale ochraceous spores.

8. **R. Queletii** Fr. (sensu restric.).

Diag.: Medium to small; cap 4—8 cm, convex or slightly gibbous, very dark purple (o 1—n 3), soon fading to pale purple, wine-red or lilac (n 4—n 7), at last dirty-white or pallid (never greenish). Edge almost smooth. Gills whitish, becoming somewhat dingy-cream or dust-grayish, not beaded with drops. Stem pruinose, flushed with purplish or pale vinous-red (m 4—n 7). Flesh pinkish-purple under the cuticle, very acrid. Sporepowder whitish.

Spores oval-spheric, 7½—8½ × 6½—7 μ, spinulose-warty.

Fig. specim.: D. A. 893, Årup, dense plantation of Picea on low ground, gregarious, Oct. 1904. Very common in similar localities. Clearly distinct from *expallens*, although very close to it. The young gills and the flesh are never pale sulphur. Fries (who had it from Quélet) evidently had but a very vague conception of it (shown by his placing it close to *R. foetens* and *fellea*). As it is one of the most common *Russulas* in our Picea-woods, it is very likely that he confounded it with other species notably *R. emetica.* (His words about the colour of the stem in this species: »albo rubellove« — while the true *emetica* always has a pure white stem — may point in that direction).

COOKE (loc. cit.) plate 1028 is a very good portrait. In the original diagnose the gills are said to be beaded with drops; but this probably may be explained by a confounding with *R. expallens* (vide Romell loc. cit.).

9. **R. sanguinea** (Bull.) Fr.

Diag.: Medium or rather small; cap about 7 cm, convex to slightly depressed, dry, bright pinkish-scarlet (m 7—m 6), edge even. Gills crowded, very narrow, distinctly decurrent, pale

cream. Stem solid, flushed with pink (m 4—m 3). Flesh firm, hard, very acrid. Sporepowder cream-white.

Spores subspheric-oval, $8^1/_2 \times 6^1/_2$ µ, spinulose-warty.

Fig. specim.: D. A. 896, Tange near Kværndrup, solitary in grass under Pinus. Not rare in woods of Pinus. — A very distinct species easily recognized from *R. emetica* by the narrow, decurrent gills, the pinkish stem etc.

10. **R. luteotacta** Rea (= *R. sardonia* Bres.).

Diag.: Rather small; cap 3—6 cm, convex, bright scarlet-pink (m 6—m 5), paler towards the edge, and often quickly fading to ivory-white, slimy-viscid. Gills crowded, narrow, adnate, beaded with drops. Stem white, turning golden chrome-yellow (14—13) when touched (like the gills and other parts). Flesh very acrid. Sporepowder white.

Spores subspheric, $8^1/_2 \times 7^1/_2$ µ, warty. Gill's edge (and face) set with fusiform cystidia (about 10—13 µ broad).

Fig. specim.: D. A. 900, A: Hollufgård, mixed frondose copse. Aug. 1915. B: Hjallese, gregarious in mixed frondose wood, Aug. 1917.

The name *R. luteotacta* is very appropriate. The figure and description in Bresadola's *Funga Tridentini* is excellent. Also *R. sardonia* in Bataille's monograph belongs here.

11. **R. emetica** (Schaef.) Fr. (sensu restr.).

Diag.: Medium to rather large, Cap 6—9 cm, convex, slightly depressed, pure pinkish scarlet or light blood-red (m 7), paler in the middle and often quickly fading to whitish in places or all over. Margin at last coarsely striate. Gills white, somewhat distant, almost free. Stem rather tall, white, somewhat spongy. Flesh fragile, very acrid. Sporepowder white.

Spores large, $9—10^1/_2 \times 7^1/_2—8^1/_2$ µ, spheric-oval, coarsely warty-spinulose. Cystidia fusiform-cylindric.

Fig. specim.: D. A. 897, Gerup Skov (Holstenshus), in Sphagnum-bog, growing scattered under Pinus-trees, Aug. 1902 (and later years). — This beautiful species, excellently figured by Fries (»*Ätliga Svampar*«), appears to be indigenous to pine-woods on boggy ground. In the island of Fyn it is consequently rare, while it is not uncommon in the coniferous woods of Jylland (Povl Larsen). It is larger, slenderer, more vivid scarlet and more quickly fading than the next species, but running into it without any distinct delimitation. The spores are considerably larger (always?).

12. **R. fragilis** (Pers.) Fr. (sensu restr.).

Diag.: Rather small; cap 3—7 cm, convex to flat, pure scarlet-rosy (m 6) or pink (m 5—m 4), edge slightly striate. Gills white,

somewhat crowded, not rounded-free behind. Stem white, attenuated upwards, brittle. Flesh very acrid. Sporepowder white.

Spores subspheric-ovate, 7—7 1/2 × 5 3/4 µ, spinulose-warty. — Cystidia on epiderm fusiform-clavate, about 6 µ broad; hyphæ somewhat pinkish, about 2 µ broad (1924).

Fig. specim.: D. A. 898, Langesø, gregarious in wood of Fagus, Oct. 1919. Very common in woods of Fagus, often on and around stumps, even late in the autumn. — Deep-coloured specimens are pink under the epiderm like no: 11.

12a. **R. fragilis** var. *nivea* (Pers.).

Cap from the beginning white with a slight tinge of ivory. For the rest like the main species.

Fig. specim.: D. A. 899, Årup, wood of Fagus, Sept. 1910; rather rare.

R. fragilis in the sense of FRIES evidently covers several species, like his *R. emetica*. I use the name exclusively for the little scarlet-pink beech-wood fungus. Also some modern authors, f. inst. SINGER in *Die Taublinge Mitteleuropas* (Zeitsch. f. Pilzkunde 1923, Heft 2) include small fungi of all colours under this name. I cannot share this view.

13. **R. fallax** (Schaef.). (*R. violacea* Quél.).

Diag.: Small; cap 3 1/2—5 1/2 cm, convex, soon depressed, with sulcate edge.

Colour sordid purple (n3), pale towards the edge (n7) and very dark (almost black or somewhat olivaceous) — but soon fading to whitish — in the middle. Gills rather broad, white, all equal. Stem venose-striate, white. Flesh thin, spongy, very acrid, white under the cuticle. — Sporepowder cream-white.

Spores almost spheric, 8 × 7—7 1/2 µ, wartly-spinulose. — Cuticular hyphæ about 2 1/2 µ; cystidia filiform-clavate, about 6 µ (1924).

Fig. specim.: A. D. 894. Gerup (Holstenshus) in grass, wood of Betula and Picea, Aug. 1914 etc. Also met with, but more rarely, in frondose woods (Quercus, Fagus), chiefly on moist ground or in somewhat boggy places, lake-shores etc.

The white stem and deeply sulcate edge distinguish it from small forms of *R. Queletii*. The purplish colour and dark or olivaceous centre clearly separate it from *R. fragilis*. — COOKE (loc. cit. tab. 1059) depicts a rather pale form. The descriptions of *R. fallax* and *R. violacea* (f. inst. in BATAILLE's monograph) are almost congruent.

14. **R. serotina** Quél.

Diag.: Very small; cap 2—3 cm, centre very dark sordid purple (o2), shading off (o3) through olivaceous and pale pinkish to

almost white towards the edge, which is almost even. Surface (sub lente) with a faint mealy bloom. Gills crowded, narrow, edge minutely eroded. Stem white, minutely powdery. Flesh acrid. Sporepowder white.

Spores almost spheric, minutely warty-spinulose, $7^1/_2$—$8 \times 7\,\mu$.

Fig. specim.: D. A. 895, Hjallese, dense copse of Quercus and Corylus etc., gregarious Aug. 1914. Very much like small specimens of the preceding species, but apparently distinct.

2. Insipidæ.

15. **R. Linnæi** Fr. (ex Rob. Fries) (nec Rick.).

Diag.: Very large; cap 9—11 cm, convex, bright rosy-scarlet or light bloodred (d 3—m 6), of one colour, dry, edge almost even. Gills at first white, then cream, subdecurrent, basifurcate, but rarely branched. Stem short and stout ($2^1/_2$—$3^1/_4$ cm thick) more or less flushed with the colour of the cap. Flesh firm, hard. but becoming spongy in the stem. Sporepowder pure white.

Spores oval-spheric, 7—$7^1/_2 \times 6^1/_2\,\mu$. Edge of gills set with cylindric-hairshaped cystidia, about $35 \times 9\,\mu$ (protruding part).

Fig. specim.: D. A. 869, Stenløse, in wood of old, big beeches. Aug. 1917. Rare.

Ricken (and others) use the name *R. Linnæi* Fr. for *R. purpurea* Gil. But while Fries' description in *Hym. Eur.* is somewhat equivocal, that in *Icones selectæ* (by Rob. Fries) leaves no doubt as to its close affinity to *R. lepida*. In fact it is very questionable if it is anything but a gigantic and rich-coloured form of this species.

16. **R. lepida** Fr.

Diag.: Rather large; cap 5—8 cm, convex, dry, often somewhat cracking in all directions, bright pink (m 5) to pale pinkish-flesh-colour (d 8—m 4) (often whitish in places), somewhat granulate, edge even. Gills almost free, cream-white. Stem flushed with light pink. Flesh very hard and dry. Sporepowder white.

Spores oval-spheric, $7^1/_2 \times 6^1/_2\,\mu$, warty.— Hairs on surface of cap 3—4 μ broad, septate; no cystidia (1915).

Fig. specim.: D. A. 868, Hunderup Skov, under old beeches, Aug. 1900. Not uncommon, in woods of Fagus.

Var. *alba* Quél. is occasionally met with (is this form really distinct from *R. lactea* (Pers.)?); and also a form with a cream-yellow cap, slightly flushed with flesh-colour (almost like *R. aurora* Bres.).

17. **R. rosea** (Schaef.?) Quél.

Diag.: Medium or rather large; cap 5—9 cm, somewhat depressed slightly viscid, cuticle separable, pure light pink (d 6—m 4),

(centre somewhat fulvous flesh-colour (d6—g2)), and often whitish-pale in spots. Edge obsoletely striate. Gills rather crowded, milky white, basifurcate, occasionally branched. Stem rather slender (5 × 1½ cm), broader immediately under the gills, white, somewhat rugose-venose and set with granular squamules, which are somewhat reticulately arranged. Flesh white under the epiderm, inodorous, rather firm but very thin towards the edge of the cap. Sporepowder white.

Spores oval-spheric, 7½—8 × 6½ μ, very minutely warty-spinulose.

Fig. specim.: D. A. 888, »Kohaveskov« to the south of Tommerup station, Aug. 1915, somewhat gregarious in wood of Fagus. — Also at Langesø, similar locality, Sept. 1925.

A rare and beautiful species. It has nothing to do with the *R. vesca* of Rea, of which he makes it a synonym.

18. **R. lilacea** Quél.

Diag.: Rather small; cap up to 6 cm, at last profoundly depressed, lilac-pink (m4—n7), centre darker, somewhat sordid, edge fading to almost white, sulcate. Cuticle easily separable. Gills broad, entire, free, rather distant, pure white. Stem white, very slightly flushed with pale pink, brittle and soon hollow. Flesh soft, insipid, very thin in the cap towards the edge.

Spores oval-subsperic, 7½ × 6 μ, minutely warty-spinulose.

Fig. specim.: D. A. 890, Fjellebro near Kværndrup, wood of Fagus (a solitary rather old specimen, Aug. 1914). Also found at Hjallese (mixed frondose wood, July 1915), a younger, flatter specimen with narrower gills and a more sordid-lilac colour.

19. **R. carnicolor** Bres.

Diag.: Rather small; cap 5½ cm, pallid flesh-colour (d8—j1), centre brownish ochre (j1—g3), edge striate. Gills rounded-free behind, basifurcate, pure white, distant. Stem pure white, soon somewhat hollow.

Spores oval-spheric, 7—7½ × 6 μ, minutely warty-spinulose.

Fig. specim.: D. A. 889, Hjallese, solitary in mixed frondose wood, Aug. 1915. — Very close to no: 18 and perhaps not specifically distinct.

20. **R. vinosa** Quél.

Diag.: Medium or rather small; cap about 6 cm, dull vinaceous purple (n4), centre either dark (subfuscous) or fading to clay-brownish or pallid; edge even. Gills narrow, rather crowded, whitish. Stem at first white, firm, but soon becoming reticulately veined and livid-grayish (inside and outside), especially in wet weather. Insipid and inodorous.

Spores oval-spheric, 8 × 6½ μ. — Cuticular cystidia numerous, elongated-clavate, about 6 μ broad. Hyphæ 2—3 μ (1924).

Fig. specim.: Hjallese, in open grassy space in frondose copse, September 1913. Not uncommon.

Cooke's fig., tab. 1021, of *R. depallens* probably depicts an old and faded specimen of this species, not of no: 21. I regard *R. vinosa* as a distinct species, not as a variety of *R. depallens*.

21. **R. depallens** (Pers.) Fr.

Diag.: Medium; cap 5—8 cm, convex, at last slightly depressed, edge dull pale purplish (i1—n7), for the rest fading to a dingy whitish ochre (k2—b7). Edge rather acute, at last slightly striate. Cuticle viscid, rather firmly adnate. Gills uncommonly narrow, rather crowded, white, turning sordid brownish when touched like the at first whitish, rather firm but soon spongy stem. Flesh insipid, whitish at first, but changing slowly with age to dull brownish-sordid, especially towards the base of the stem. Sporepowder white.

Spores oval-spheric, 8½—9 × 7½—8 μ, warty-rough.

Fig. specim.: D. A. 886, Højsholt (Tommerup), gregarious in wood of Fagus, Aug. 1915.

A very characteristic species, totally different from *R. vinosa*. — I have never met with it again, but refer it to *R. depallens*, the descriptions of which by Fries and Ricken fit my plant fairly well. R. depallens in the sense of Rea does not belong here.

β. Versicolores.

1. Acerrimæ.

22. **R. foetens** (Pers.) Fr.

Diag.: Very large; cap 8—13 cm, at first bullate, strongly tuberculate-sulcate when expanding, sordid ochraceous or almost brownish (k5—k6), with a viscid, coarse, firmly adnate cuticle. Gills beaded with drops, dingy white, often spotted with sordid ochre-brown. Stem stout, whitish, soon hollow (one or more separate cavities). Flesh firm, but brittle, stinking, very acrid.

Spores large, subspheric, 9—10 × 8 μ, coarsely warty-spinulose (warts about 1½ μ). — Even higher power lenses do not reveal to me any reticulations on the spores (as seen by some authors) (1920). — Cuticular hyphæ hyaline, 3—3½ u broad; »cystidia« not distinctly differentiated from the coarser hyphæ (1924).

Fig. specim.: D. A. 873, Hjallese, in copse of Corylus and Quercus, gregarious, Sept. 1897. — Very common.

23. **R. livescens** (Batsch) Bat.

Diag.: Medium; cap 4—7 cm, at first slightly, then broadly depressed, edge becoming strongly tubercular-sulcate. Cuticle livid-brownish (o 6—h 2) or pallid sordid (c 7—h 4), thick, viscid. Gills pallid, becoming somewhat sordid when touched. Stem pallid, becoming somewhat sordid. Flesh of cap rather thin, sordid under the cuticle; that of the stem somewhat hollow, generally with a series of cavities. Odour faint, disagreeable (reminding one of *foetens*); taste acrid. Sporepowder white.

Spores spheric oval, 7—8 × 6 μ, rather coarsely warty.

Fig. specim.: D. A. 871, Årup, in grass on a hill in outskirts of wood of Pinus, gregarious, Sept. 1912. Not uncommon in open spaces in pine-woods.

R. consobrina var. *intermedia* (Cooke's Ill. tab. 1056) and var. *soronia* (ibd. tab. 1057), probably are synonymous. But Fries' figure of the latter in *Icones selectæ* is very different. What the typical *R. consobrina* Fr. really is I do not know.

24. **R. livescens** var. *depauperata* J. E. L.

Diag.: Small; cap 3—6 cm, slightly depressed, almost membrannaceous, livid-gray or dirt-brownish (c 5—o 6), edge paler (c 7—h 4), tubercular-sulcate half way in. Gills whitish, basifurcate, equal, rather, distant. Stem whitish, at last dirt-grayish, becoming hollow. Flesh whitish, insipid and almost inodorous (slight *foetens*-smell in young specimens, 1924). Sporepowder white with a slight tinge of dirty cream.

Spores 8—8½ × 6—6½ μ, subspheric-oval, with rather low warts.

Fig. specim.: D. A. 872, A: Fruens Bøge, wood of Fagus etc. Aug. 1900. B: same locality, July 1903 (young). Also at Vemmetofte on coast-common under Populus and Pinus. Oct. 1924.

Smaller, paler, more membranaceous than no: 23, and insipid.

25. **R. simillima** Peck.

Diag.: Medium; cap 4—7 cm, rather flat with firmly adnate viscid pellicle, ivory-white to ochraceous (b 7—b 6) or light crust-brown (e 7); margin sulcate. Gills narrow, rather crowded, beaded with drops. Stem white, slightly ochraceous when touched, not hollow. Flesh very hard, brittle, almost inodorous, very acrid. Sporepowder pure white.

Spores oval-spheric, 7—8 × 6 μ, with coarse warts. — (Not visibly reticulated, 1920).

Fig. specim.: Hjallese, mouldy ground in copse of Quercus and Corylus, gregarious, Sept. 1903. Not uncommon in similar localities.

Described very well by PECK (ex Saccardo V). Probably *R. subfoetens* is identical. It comes rather close to the description of *R. pectinata* (Bull.) in Fries' *Hymenomycetes Eur.* — a species unknown to me — but can hardly be identical, as *R. p.* is said to have unbeaded gills and the cap »obscuriore fuscescente« in the middle, while *R. simillima* is of one colour (somewhat lighter than *R. foetens*).

26. **R. ochroleuca** (Pers.) Fr.

Diag.: Rather large; cap averaging 7—8 cm, soon somewhat depressed, edge even or slightly striate, colour bright yellow-ochre (b6), occasionally flushed with light crustbrown or pale. Gills pure white, subdistant. Stem often rather tall, white, but in moist weather slowly changing (inside and outside) to watery grayish, base often somewhat cracked-squamulose, clay-brownish (g6) or subfuscous (= var. *granulosa* (Cooke, Rea). Flesh rather firm, almost insipid. Sporepowder white.

Spores $8—8^1/_2 \times 6^1/_2—7$ µ, oval-spheric, warty-spinulose. — Cuticular hyphæ 2—3 µ broad, the coarser ones amber-yellowish, the finer ones almost hyaline (1924).

Fig. specim.: D. A. 876, Vissenbjerg, hilly wood of Fagus, Aug. 1905. Common in woods of Fagus and mixed woods (Fagus + Picea).

R. ochroleuca is generally said to be acrid. But in Denmark the almost insipid form is prevalent — in fact I have never met with really acrid specimens. The characterization as acrid may originally rest on a confusion with *R. fellea*. *R. citrina* Gil. (nec Quél). (COOKE tab. 1078) appears to be very closely allied, if not identical, and so is *R. fingibilis* Britz., to judge from Cooke's figure (tab. 1048).

27. **R. fellea** Fr.

Diag.: Medium to small; cap 4—7 cm, campanulate-convex, at last expanded; gilvous-ochre (e6), edge paler, slightly striate gills rather narrow, very pale gilvous (b8—k2) like the stem (and even the flesh). Stem often somewhat conical, not hollow. Flesh very pungent. Sporepowder white.

Spores almost spheric, 8×7 µ, minutely warty. (Not reticulate (1920)). Cuticular »cystidia« somewhat ochre-brownish, filiform-clavate, $5—7^1/_2$ µ broad; hyphæ about 2 µ, almost hyaline (1924).

Fig. specim.: D. A. 875, Hollufgård, wood of Fagus. Sept. 1902. Common as well in frondose as in coniferous woods. — Very well characterized by the very pale gilvous tint of all its parts.

2. Insipidæ.

28. **R. violeipes** Quél.

Diag.: Medium; cap 6—8 cm, convex, at last somewhat depressed, edge almost even. Cuticle originally pale sulphur (12—11), sub lente minutely mealy-atomate; but when the at first colourless »meal« becomes violet-purple, the colour of the cap changes to dull olive or even dingy purple (o3) in places. Gills very narrow, crowded, white. Stem mealy, white to very pale sulphur, often — especially with age — flushed with purple (o3—n7) like the cap. Flesh rather thin, but very hard. Sporepowder milk-white.

Spores oval-spheric, 7—8 × 6¼—7 μ. — The »meal« on the stem is formed of long, about 7 μ broad, pale lilac hyphæ; that on the cap of similar hyphæ, the end-cells of which are often swelled to about 15 μ diam. (1917—24).

Fig. specim.: D. A. 867, A: Vissenbjerg, hilly wood of Fagus, Aug. 1905; B: Ågård, near Kolding, wood of Fagus, Sept. 1905. Rather rare.

Over-ripe specimens, in which the mealy bloom has become deep purple and the cap somewhat striate, are like *R. amoena* Quél.; very young ones, without any purple shades, are *R. citrina* Quél. (nec Gil.) and probably also *R. albido-lutescens* Gil. *R. olivascens* sensu Singer (loc. cit.) is synonymous, and so is *R. punctata* (Gil.) Maire. (But as Gillet's description is totally misleading (Gillet, loc. cit. p. 245, plate 56) I discard this name, in spite of priority). Most authors describe the sporepowder as somewhat yellowish. I have always found it milk-white. The great number of names attached to this very characteristic species evidently can be accounted for by the totally different colours of the cap when the »meal« is white and when it becomes purple.

29. **R. virescens** (Schaef.) Fr.

Diag.: Large; cap 7—10 cm, at first almost bullate, soon convex, light dull green (f1) to almost milkwhite with a slight tinge of greenish (e1). Cuticle double, the outer one soon cracking in all directions into minute granulate patches. Gills white. Stem white. Flesh hard and firm in all parts. Sporepowder pure white.

Spores oval-spheric, 6½ — 7 × 5½ μ (A). — The outer, granulate strata of the cuticle is formed partly of oval-spheric, vesiculose cells (12—15 μ in diameter), partly of about 4 μ broad hyphæ (1914).

Fig. specim.: D. A. 864, A: Hunderup, wood of Fagus, Aug. 1904, B: »Egeskov«, wood of Fagus, Aug. 1914. Not common, chiefly met with in rather dry woods of Fagus in hilly, exposed places.

30. **R. cutefracta** Cke.

Diag.: Medium; cap 6—7 cm, convex, slightly depressed, dingy lilac-purple (o3—o2) with a tinge of olivaceous, disc fading to pallid clay-brownish (h4—c7); cuticle towards the edge cracking in all directions, thus bringing to view the pale purple flesh. Gills narrow, subdecurrent, white. Stem rather tall, white. Flesh firm. Sporepowder white.

Spores oval-spheric $7^1/_2 \times 6$ µ, minutely warty. — Cuticular hyphæ 3 µ broad, rather straight and but slightly branched, occasionally with basidiiform, 6—9 µ broad terminal cells (cystidia?) 1924.

Fig. specim.: D. A. 865, Årup, in a hedge under Corylus and Fagus, Oct. 1901. Rather rare.

Like Cooke (*Illustrations*, tab. 1040) I have also met with a somewhat greenish variety, more minutely cracked (almost after the manner of *R. virescens*). Rea (loc. cit.) says the spores are ochraceous, but this is distinctly against Cooke himself.

Whether it be anything but an »atmospheric variety« of *R. cyanoxantha* is rather questionable.

31. **R. cyanoxantha** (Schaef.) Fr.

Diag.: Large; cap 7—11 cm, convex slightly depressed, edge even; colour variable: in some forms (fig.) pale lilac flesh-colour (o8—m3), flushed with dingy purplish (o3), in others much darker: olive to sordid green (f3—f4), flushed with deep shades of sordid purple. Gills white, rather narrow. Stem always white, often rather tall. Flesh under the cuticle always purplish flesh-colour, rather firm, but becoming spongy in the stem.

Spores almost spheric, $7^1/_2$—9×6—7 µ, with but little prominent, low warts.

Fig. specim.: D. A. 883, Hunderup, on humid ground in frondose wood, Aug. 1903. Very common, especially in beech-woods.

32. **R. heterophylla** Fr. (forma *viridis*).

Diag.: Rather large, cap about 8 cm, somewhat depressed, cuticle green (f7—i5), centre pallid or slightly flushed with somewhat sordid-violaceous tints, edge about even, slightly grayish lilac. Gills very narrow, crowded, white, somewhat decurrent. Stem cylindric, white. Flesh white, firm, becoming somewhat spongy. Sporepowder white.

Spores oval spheric, 8—$8^1/_2 \times 7$ µ, minutely warty spinulose. Cuticular hyphæ greenish-hyaline, ca. $2^1/_2$ µ broad (1924).

Fig. specim.: D. A. 880, Tommerup, on rich, clayey soil in mixed frondose wood, gregarious, July 1914. Not uncommon but generally more olivaceous with purplish shades, occasionally very dark (f4—f5).

The only fairly reliable means of distinguishing this species from olivaceous forms of the preceding one is the want of reddish colour in the subcuticular flesh. Nevertheless the extreme forms are so unlike each other, than one hesitates to unite them in one species.

33. **R. heterophylla** var? (*R. mustelina* Fr.??).

Diag.: Large; cap 10 cm, strongly convex, slightly depressed, dry (sub lente somewhat rough), dark olive-brown (c3) (edge and centre paler, almost dingy clay (h2—h3)), edge even. Gills somewhat crowded, rather thick, white, edge somewhat spotted with yellowish stains, attenuated towards the stem, somewhat basifurcate. Stem white, stout and short. Flesh hard (thin towards the edge). Sporepowder white.

Spores oval-spheric, indistinctly warty, small (7 × 6 μ).

Fig. specim.: D. A. 882, Hunderup, wood of Fagus, exposed position, July 1905, solitary.

On account of its stature (between *Heterophyllæ* and *Compactæ* Fr.) and its brown colour I originally referred this peculiar Russula to the somewhat problematic species *R. mustelina*. But I am now inclined to think it is simply a very robust, dull brown-coloured form of *R. heterophylla*. — What *R. mustelina* really is I do not know. SINGER (»*Die Taublinge Mitteleuropas*«) makes of *R. m.* a synonym of *R. elephantina* (also a very problematic species and says the gills at last become yellow. MICHAEL (loc. cit.) figures sub nom. *R. mustelina* an ochre-brown, yellow-spored species.

34. **R. galochroa** Fr.

Diag.: Rather large; cap 7—8 cm, soon depressed, cream-white (b8) (somewhat dingy with age), edge minutely striate-sulcate in fully expanded specimens. (In specimens from Hæsbjerg a slight bloom of a greenish tint was seen in the centre). Cuticle not very firmly adnate. Gills narrow, crowded, white to somewhat cream, basifurcate and with some few short ones, adnate-decurrent. Stem white, rather smooth. Flesh firm, at last spongy, white. Sporepowder white with a slight tint of dingy yellowish.

Spores rather small, 7—7½ × 6 μ, oval-spheric, warty.

Fig. specim.: D. A. 881, Hesselagergård, in wood of Fagus (in two localities), July 1914. — Also Hæsbjerg (1915).

Very close to *R. heterophylla*. It might be regarded as an albino of this species, if it was not for the slightly yellowish tinge in gills and spores.

35. **R. vesca** (Fr.) Romell (nec al.).

Diag.: Medium; cap 6—7 cm, at first convex, then slightly depressed, brownish flesh-colour (j2—o8) (often rather pale), edge almost even. The cuticle does not cover the front of the gills

for the last 1—2 mm. Gills white, subdecurrent, when young somewhat beaded with drops. Stem white, somewhat venose-striate. Flesh firm, unchangeable. Sporepowder pure white.

Spores oval-subspheric $7^1/_2 \times 6\ \mu$, minutely warty-spinulose.

Fig. specim.: D. A. 885, Langesø, wood of Fagus, Aug. 1915. Not rare, in beech-woods.

This characteristic species differs somewhat from the description of Fries, especially in not having a strongly reticulate-rugose cap. The naked gills (which show like a row of teeth along the edge of the cap) is a very distinct character. It is not unlike some forms of R. cyanoxantha. — The *R. vesca* of MICHAEL (loc. cit.) appears to me to be *R. vinosa*. *R. vesca* of RICKEN does not belong here; but that of BRESADOLA is almost identical.

36. **R. olivascens** Fr.

Diag.: Rather large, cap 7—9 cm, somewhat depressed in the middle, edge but slightly striate with age. Colour pallid yellowish-olive-green (f7—f8), centre fading to whitish yellow (e5—k4), flushed in places with olive-brownish. Gills less crowded than in R. heterophylla, basifurcate, but with no shorter ones, at last cream-yellow, not very narrow. Stem firm, white, at last tinged slightly fuscous-ochre. Flesh under the cuticle somewhat rubescent (also when the cuticle has been eaten away by slugs), insipid, rather firm. Sporepowder almost pure white (not yellowish).

Spores oval-speric, $7—7^1/_2 \times 6\ \mu$, warty. — Cuticular hyphæ $2—3\ \mu$ broad, pale greenish. No »cystidia« but occasionally some coarser hyphæ among the thin ones (1924).

Fig. specim.: D. A. 884, Ravnholt, wood of Fagus, Aug. 1917. Rather rare. — *R. olivascens* Rick. seems to be *R. violeipes*. *R. o.* of REA and QUÉLET, with deep ochraceous sporepowder, does not belong here but probably to *R. olivacea*.

No: 30—36 are all very intimately related species forming a series clustering around *R. heterophylla—cyanoxantha*. All of them are rather small-spored.

37. **R. azurea** Bres.

Diag.: Small; cap $4^1/_2$—6 cm, depressed, edge almost smooth; cuticle separable, greenish gray (c4—f2) or almost pigeon-blue, with a delicate white bloom (which under a strong lens has a somewhat mealy appearance), centre fading to pallid clay. Gills milk-white, somewhat basifurcate, equal. Stem white. Flesh thin, insipid. Sporepowder milkwhite.

Spores subspheric-oval, $6^1/_2—8 \times 5^1/_2—6\mu$. — Cuticular hyphæ rather broad and straight ($3—3^1/_2\ \mu$); »cystidia« rather sparse, clavate, about $6—8\ \mu$ broad (1924).

Fig. specim.: D. A. 866, »Fruens Bøge«, wood of Fagus, July 1909. Not uncommon in frondose woods. Very well figured by BRESADOLA and COOKE. Never »azure-blue«.

38. **R. graminicolor** (Secr.) Quél. = *R. æruginea* Lindbl.

Diag.: Medium or rather small; cap 6—8 cm, soon depressed, edge striate, cuticle separable, pallid olive-greenish (f1), pale towards the edge (occasionally almost whitish). Gills rather broad, becoming somewhat cream (b8), often spotted fuscous with age. Stem white. Flesh insipid, soon rather spongy. Sporepowder creamy.

Spores spheric-ovate, 7—7½ × 6 μ, minutely spinulose. — Cuticular cystidia about 6 μ broad (content somewhat granular) (1924).

Fig. specim.: D. A. 878, Langesø, under old Betula, Aug. 1917. Common in woods of Betula.

38a. **R. graminicolor** var.

Diag.: Rather large; cap 9—10 cm; cuticle somewhat separable (edge somewhat tubercular-striate) becoming bright and pure light green (h 8—i 6), especially in the middle. Gills rather broad, slightly creamy. Stem white, rather stout. Flesh rather firm, mild.

Spores small (6½ × 5½ μ).

Fig. specim.: D. A. 879, Hjallese, copse of Quercus and Corylus (no Betulas observed), gregarious, Sept. 1905.

Intermediate between *R. heterophylla*, *R. viridis* and *R. graminicolor*; but probably a large and rich-coloured variety of the latter.

Very much like the big specimen figured by FRIES in »*Icones sel.*« (pl. 173).

39. **R. smaragdina** Quél.

Diag.: Very small; cap 2—3½ cm, somewhat depressed, edge minutely striate, cuticle separable, pale yellowish green (h7—i8) in the centre, almost white towards the margin. Gills white. Stem white with a series of cavities. Flesh with a faint acrid aftertaste. Sporepowder white to cream.

Spores oval-spheric, 8—8½ × 7 μ, warty-spinulose.

Fig. specim.: D. A. 877, Hjallese, gregarious in copse (Quercus, Corylus), Aug. 1915. Also at Hollufgård, Aug. 1915.

Almost a very pale miniature of *R. graminicolor*.

B. Xanthosporæ.

α. Rubentes.

40. **R. aurata** (With.) Fries.

Diag.: Rather large (8—9 cm); cap somewhat depressed, of a splendid orange-yellow (16—17) colour, variegated with tinges of dark golden or copper-red (j8); edge even. Gills light yellowish, edge pure chrome-yellow, rather broad. Stem white with flushes of yellow. Flesh firm, white, yellow under the cuticle. Sporepowder yellow-ochre.

Spores 8—9 × 7—7½ μ, spheric-oval, warty. Edge of Gills densely set with cystidia. The yellow colour is not particularly attached to these.

Fig. specim.: D. A. 901, Hunderup, wood of Fagus, Oct. 1896. Rather rare in woods of Fagus, in somewhat dry and exposed places. — The chrome-yellow edging is occasionally almost wanting.

41. **R. atropurpurea** (Krombh.). (*R. Clusii* Bat. (?)).

Diag.: Very large; cap 9—12 cm, convex, dark dull blood-red (d1), edge almost smooth. Gills whitish, with a dirt-yellowish tinge, somewhat decurrent (occasionally divided and with some few short ones). Stem very stout, (2—2½ cm thick), whitish, surface somewhat granulate-cracked and with a tinge of clay-brownish (especially towards the base). (In a later find the young stem was slightly flushed with pale pink). Flesh firm, thick, insipid (in young specimens from another locality somewhat acrid), whitish. Sporepowder pure white.

Spores almost spheric, 9 × 7¾ μ, bluntly warty.

Fig. specim.: D. A. 870, »Højsholt« near Tommerup, gregarious in wood of Fagus with old Piceas, Sept. 1910. (Also Årup Kohave, wood of Quercus and Fagus, Sept. 1912 and »Fjellebro«, Aug. 1914.

The figure 1087 in Cooke: »*Illustrations*«, which he identifies with *Ag. atropurpureus* of Krombholz, is very like my plant. He calls it *R. rubra* var. *sapida*. It differs from *R. purpurea* in the white, not strongly reticulate stem, the pure white sporepowder etc. I have not noted any decoloration of the flesh as in *R. purpurea*. Maire (loc. cit. pag. 167) characterizes *R. atropurpurea* in a way which corresponds very well with my plant. Also the description given by Bataille for *R. Clusii* is very near to mine, but my specimens were much larger.

42. **R. purpurea** Gill. (*R. Linnæi* Rick. nec Fr.).

Diag.: Rather large; cap 8—11 cm, convex to slightly depressed. Cuticle deep blood-red (d2), often very dark in centre, edge lighter (even almost scarlet-pink), smooth or nearly so. Gills

broad, almost free, cream to pallid ochraceous. Stem strongly reticulate-venose, more or less flushed with purplish pink (m 5—n 6) (except immediately below the gills), becoming dirt-brownish-ochre (g 6—g 7) when touched, like the gills and the flesh when cut. Flesh rather firm (I have not noticed any particular odour in fresh specimens), insipid. Sporepowder whitish-ochraceous to cream.

Spores subspheric, 9—9 1/2 × 7 1/2—8 μ, warty-spinulose.

Fig. specim.: D. A. 902, Tange, in grass under old Pinus silvestris in a meadow, Oct. 1914. Rather common in woods of Pinus silvestris, rarely met with in other places. —

Ricken describes this species sub nom. *R. Linnæi.* Ferdinandsen & Winge call it *R. xerampelina* Fr.

43. **R. graveolens** Romell (sensu restr.).

Diag.: Rather large; cap 8—10 cm, convex, edge even. Cuticle in the middle pale yellowish olive (h 3), shading off towards the margin into dull, pale pink (n 6—o 8). Gills cream to pale ochraceous, rather broad, connected by veins, somewhat rounded behind. Stem somewhat granulate and rugose, white (or slightly flushed with pink), decolorating after the manner of the preceding species when touched, like the flesh and gills. Flesh insipid, with a faint smell of crab. Sporepowder whitish-ochre.

Spores oval-spheric, 9—9 1/2 × 7 1/2 u, prickly.

Fig. specim.: D.A. 905, Kohaveskov near Højsholt (Tommerup), wood of Fagus, Aug. 1915, gregarious. — Rather rare, in frondose woods. — Chiefly differing from no: 42 by habitat and colour. — *R. xerampelina* sensu Rea (et al.) is evidently identical, and so is *R. olivacea* Fr. ex Ferdinandsen & Winge (loc. cit.) and others; but Schaeffer's (and (Fries') *R. olivacea* has pure yellow or even somewhat saffron gills (like *alucatea*), while the present species has creamy gills. (Vide Schaeffer's Icones, tab. 204).

44. **R. alutacea** (Pers.) Fr.

Diag.: Very large; cap 8—13 cm, depressed, edge almost even. Cuticle (sub lente) slightly rough (or rather delicately transversely-filamentose), fundamental colour dull Lamium-red (n 4), paler towards the edge (n 7), shaded with dark olivaceous in the centre. Gills broad, at first cream, soon becoming rich ochraceous. Stem stout, white, more or less flushed with bright pink (m 4) from apex downward. Flesh firm but soon becoming spongy, unchangeable. Sporepowder deep yellow-ochre.

Spores almost spheric, warty-spinulose, 8—9 × 7—7 1/2 μ. — Cuticular hyphæ about 3 μ broad, not clearly distinguished from the somewhat coarser, pinkish filaments (1924).

Fig. specim.: D. A. 903, Hunderup, wood of Fagus, gregarious, July 1900. — Very common in woods of Fagus.

44a. **R. a.** var. *olivacea* Schaef.

Differing from the main type by the dull olivaceous (h 2), slightly purple cap. The pinkish zone at apex of stem is often almost obsolete.

Spores oval-spheric, 8—9½ × 7½ μ.

Fig. specim.: D. A. 904, Hjallese, wood of Fagus, Aug. 1918. Connected by many intermediate forms with the type.

44b. **R. a.** var. *roseola* J. E. L.

Differs from the typical R. a. by want of olivaceous tints. The purplish-pink colour (n 6) soon fades, especially in the middle, to ivory-white. The pink zone is often very faint. — Rarer than the type.

Fig. specim.: D. A. (supplement), Langesø Sydskov, in wood of Fagus, Sept. 1925.

Originally I used the name *R. xerampelina* for what I now call *R. alutacea*. Not only is the former name very appropriate (xerampelina = withered vine-leaves), while *alutacea* does not characterize the plant at all; but Fries' description of *R. xerampelina* in many ways fits just as well (»pileo compacto .... rimuloso-punctato .... laevi .... stipite albo rubellove« etc.), while that of *R. alutacea* (»margine tenui demum striato, tuberculoso«) is somewhat misleading. But as almost all modern authors apply the name alutacea to this big beechwood *Russula*, while the name *xerampelina* is used in different senses, I now follow suit. — *R. olivascens* of Rea probably is synonymous of my *R. alut.* var. *olivacea*.

45. **R. Romelli** Maire (sensu restr.).

Diag.: Large; cap 7—11 cm, depressed, edge slightly striate; cuticle purplish-red (n 3—n 4), centre very dark purple to almost black (n 1), but soon fading to pallid in places, viscid and somewhat shining. Gills moderately broad, basifurcate, cream to light ochraceous, entire. Stem pure white, firm. Flesh mild, becoming spongy, with a tinge of pale sulphur (b 8—11) in the upper part of the cap. Sporepowder ochre.

Spores oval-spheric, 8 × 6½, warty-spinulose.

Fig. specim.: D. A. 906, Hunderup, wood of Fagus, Sept. 1913.

Easily confounded with no: 44, but the stem is never tinged with pink, the cap somewhat shining, the edge sharper etc. Probably included in the Friesian *R. integra* (which evidently is a collective). *R. nitida* in the sense of Ricken probably is identical, although his plant is somewhat smaller. Maire (loc. cit. pag. 105), also includes yellowish-green and pale olivaceous forms; but I prefer to use this name exclusively for the purplish ones. The entirely white stem distinguish it from *R. alutacea*.

46. **R. pseudo-integra** Arn. et Goris. (ex Maire).

Diag.: Rather large (6—9 cm); cap convex-depressed, margin somewhat striate. Cuticle easily separable, bright scarlet-pink (m 6—m 7), fading to almost white. Gills rather broad, cream, becoming very pale ochre, simple. Stem white, often rather tall, spongy. Flesh mild, somewhat bitter after prolongated mastication. Sporepowder pale ochre.

Spores oval-spheric $7^1/_2$—$8^1/_2 \times 6$—$7^1/_2$, warty.

Fig. specim.: D. A. 912, Hjallese, wood of Quercus and Corylus. Aug. 1900 (and later years). — This beautiful Russula evidently belongs to the *integra*-series, but is very distinct. MAIRE gives a very detailed description of it (loc. cit. pag. 111) which entirely covers mine. I formerly referred it to *R. rubicunda* Quél. which certainly is very close to it (practically the only differences are that Quélet's species is said to be at last »âcre-poivrée« and the smell »vireuse, de pomme trop mûre«).

47. **R. substyptica** (Pers.) Bat.

Diag.: Rather large; cap 7—8 cm, depressed-flat, edge sulcate, almost tile-red (d 5), fading towards the centre into yellowish pale ochre (b 6—b 7). Gills broad, entire, connected by veins, light ochre. Stem white, dilated above, in age or when touched somewhat ochraceous. Flesh firm, soon pungent, when old with a faint but disagreable somewhat nauseating smell, which recalls that of *R. foetens*. Sporepowder light yellow-ochre.

Spores very large, almost spheric, 10—$11^1/_2 \times 9$—$9^1/_2$ u, warty-spinulose.

Fig. specim.: D. A. 911, »Fjellebro« (Kværndrup) Aug. 1914, solitary in wood of Fagus. — A very distinct species, but I have never met it again. The description of *R. maculata* Quél. in Rea's »*Brit. Basidiomycetae*« comes very near to my plant.

48. **R. veternosa** Fr. (?) Bat. forma *insipida*.

Diag.: Rather small or medium; cap 5—8 cm, depressed, edge even. Cuticle separable, light pink or pinkish flesh colour (m 4—d 8), fading to almost white (slightly ochraceous in the middle). Gills yellowish cream, soon becoming light yellow-ochre, occasionally somewhat divided. Stem always white. Flesh thin, soft, spongy in the stem, insipid or almost so. Sporepowder creamy ochre.

Spores spheric-oval, minutely warty-spinulose, $7^1/_2 \times 5^1/_2$—6 µ or $7^1/_2$—8×6—$6^1/_2$ µ (1914):

Fig. specim.: D. A. 907, Årup, wood of Fagus, Oct. 1901. Rather common.

Except for the want of acrid taste exactly like Bataille's description. Fries says the surface is »polita«; in my plant it is slightly rough (almost like kidskin). Singer's *R. veternosa* (loc.

cit.) has a red stem and does not belong here, nor does Ricken's. — I have never met with really acrid specimens.

49. **R. chamæleontina** Fr.

Diag.: Small or very small; cap 3—5 cm, edge soon becoming sulcate-striate. Colour generally at first pinkish (m3—n7) or purplish flesh-colour (n4—n7), somewhat sordid in the centre, but soon fading to pallid ochre (b7—j1). Gills cream-yellow, becoming bright ochre. Stem pure white. Flesh thin, soft, soon spongy. Sporepowder yellow ochre.

Spores oval-spheric, 8—8½ × 7 μ, warty-spinulose.

Fig. specim.: D. A. 908, St. Ernebjerg (Tommerup), dense plantation of Picea, gregarious. Common, especially in woods of Picea on somewhat low ground.

The bright ochraceous sporepowder and the constantly white stem clearly distinguish this species from *R. puellaris*, confounded with it by some authors.

49a. **R. chamel.** (?) var. *fusca.*

Diag.: Small; cap 3½—4 cm, convex, almost membranaceous, edge granulate-striate, dull date-brown (h1—h2) with a tinge of sordid purple. Gills cream, becoming rather pale dingy ochre. Stem white, subconical, spongy-hollow. Smell not noticed. Sporepowder pale ochre.

Spores subspheric-oval, 8—9½ × 6 μ, warty.

Fig. specim.: D. A. 909, A: Hunderup, in plantation of Picea and Fagus, July 1902. — B: (slightly pinkish), Vissenbjerg, Oct. 1904, wood of Picea.

The somewhat pinkish variety forms a transition to *R. puellaris.* Whether it is really a form of *chamæleontina* is somewhat dubious, but I have found no adequate description anywhere. *R. nauseosa* according to Sev. Petersen (loc. cit.) is very much like it; but Bresadola's figure (loc. cit. tab. 129) of this species is quite different.

50. **R. puellaris** Fr.

Diag.: Small; cap 3½—6 cm, convex-depressed, edge rather coarsely tubercular-striate. Cuticle separable, in the centre (sub lente) somewhat viscid-tubercular, blackish-purple (n1), shading off towards the edge into pale pinkish-purple (n4—n7). Gills rather distant, rounded behind, whitish, becoming somewhat yellowish. Stem rather slender, attenuated upward, venose-striate, yellowish, with age becoming somewhat amber-yellow (inside as well as outside). — Sporepowder white to slightly creamy.

Spores oval-spheric, 9—9½ × 7½ u.

Fig. specim.: D. A. 891, Langesø, on boggy ground under Alnus, Aug. 1913. Also Morud, in Betula-bog, 1915 etc.

The sporepowder is never yellow, at most slightly cream (vide also Bataille loc. cit. pag. 80). Fries' description is rather defective, and that of Rea (spores ochraceous, stem stained brownish etc.) is very dubious. Bresadola figures it very well (a form with deciduous scales which he calls *leprosa*).

β. Versicolores.

51. **R. basifurcata** Peck.

Diag.: Rather large; cap 6—10 cm, slightly depressed, edge almost even. Colour whitish-pale to light dirt-grayish (h5), cuticle adnate. Gills rather distant, basifurcate (some few shorter ones), white, soon becoming pallid creamy (e5—b8). Stem white, becoming pallid grayish, especially downward. Flesh rather firm, then somewhat spongy, dirty white. Taste in young specimens somewhat pungent after prolonged mastication, soon almost tasteless. Sporepowder whitish-ochre.

Spores oval-spheric, 7 × 6 μ, minutely warty-spinulose. Cystidia on edge subulate-conic.

Fig. specim.: D. A. 910, Langesø Nordskov, on sandy soil in wood of Fagus with old Pinus-trees, Aug. 1920 (and Sept. 1924). Very well figured by Beardslee (loc. cit. plate 102).

I am somewhat inclined to regard this as an albino. But having found an excellent description of it in the above-cited work I have adopted the name of Peck for my plant.

52. **R. mollis** Quél.

Diag.: Medium; cap 5—8 cm, rather depressed, edge somewhat sulcate, cuticle separable, pale yellowish-olive all over (g7—h4). Gills at first white then yellowish-ochre (b7), somewhat distant, all equal. Stem white, rather even. Flesh spongy, a little acrid, white. Sporepowder yellow ochre.

Spores rather large 9—10 × 7½ μ, oval-spheric, rather coarsely warty-spinulose.

Fig. specim.: D. A. 916, Hunderup, wood of Fagus and Quercus, Aug. 1900 (and Sept. 1915).

I refer this species (of the Friesian *integra*-tribe) to *R. mollis* Quél. after the description given by Bataille.

53. **R. cuprea** (Kromb.) Cooke (as a variety of *R. nitida*).

Diag.: Rather small; cap about 6 cm, edge striate-tuberculate, cuticle deep purplish copper-brown (j6—n4). Gills deep yellow-ochre. Stem white. Flesh light and spongy, acrid, but almost inodorous. Sporepowder ochre.

Spores oval-spheric, 8—8½ × 7 μ.

Fig. specim.: D. A. 913, Hesselagergård, solitary in wood of Fagus, Aug. 1914. (Also at Hindsgavl 1915 etc.).

Very well figured by COOKE (tab. 1093). REA (loc. cit.) gives an excellent description of it sub nom. *R. nitida* (Pers.) Fr. But FRIES' own description of *R. n.* is very vague, so I prefer the name *cuprea* to avoid confusion.

54. **R. integra** Bat. (nec al.).

Diag.: Medium to rather large; cap 6—10 cm, depressed edge striate with age, Colour deep copper-fulvous (j8—k7), slightly paler towards the margin. Gills at last rather deep yellow-ochre, broad. Stem white. Flesh somewhat spongy, insipid. Sporepowder yellow-ochre.

Spores oval-spheric, 8—8½ × 7 μ, spinulose.

Fig. specim.: D. A. 914, Hunderup, wood of Fagus, gregarious. Aug. 1915. Rather rare.

54a. **R. integra** v. *xanthophœa* Boud.

Diag.: Medium (5—7 cm), ochraceous-fulvous (k 7—g2); for the rest like the main form. —

Fig. specim.: D. A. 915, Hjallese, wood of Fagus, Aug. 1915.

54b. **R. integra** v. *lutea* Karst.

Diag.: cap medium (5½—8 cm), vivid ochre (K 3—14), centre slightly fulvous (k5). Stem rather tall. Spores somewhat smaller, 7—7¼ × 6¼ μ.

Fig. specim.: Lundeborg, open space in wood of Fagus, gregarious, Aug. 1917 (D. A. 917).

55. **R. lutea** (Huds.) Fr.

Diag.: Small; cap 3—4½ cm, edge slightly striate, deep yellow ochre (e3), centre somewhat darker. Gills rather deep ochre-yellow. Stem white, attenuated above. Flesh soon spongy, insipid. Sporepowder clear yellow-ochre.

Spores spheric-oval, 8—8½ × 6—6½ μ, warty-spinulose.

Fig. specim.: D. A. 918, Hjallese, gregarious in wood of Fagus, Juli 1903. Not uncommon.

56. **R. solaris** Ferd. et Winge.

Diag.: Small; Cap 4—6 cm, edge sulcate. Colour pure chrome-yellow (14), paler or even almost white (12—11) towards the edge. Gills at first pure white, soon becoming creamy and at last light yellow-cream. Stem white. Flesh very thin and brittle (at last hollow in the stem), very pungent (like mustard-seed); odour like mustard oil. Sporepowder very pale ochre-yellowish.

Spores 7—8 × 6 μ, oval-spheric, warty-spinulose.

Fig. specim.: D. A. 919, Højsholt (Tommerup), wood of Fagus, gregarious, Sept. 1902. Rather common in beech-woods.

This very distinct little Russula is met with everywhere in Denmark. It is described very carefully by Ferdinandsen et Winge in »*Meddelelser fra For. til Svampek. Fremme*« (1924). *R. Raoultii* Fr. ex Bataille may be a synonym, although the gills are said to be white, and the sulcate edge not mentioned. But as the description given by F. & W. leaves no doubt, I prefer this name.

R. vitellina (which I have never met) differs in having saffron-yellow gills and in its habitat (coniferous woods).

Besides the species described above some other *Russulas* are mentioned by different authors as met with in Denmark. Thus the beautiful *R. decolorans* Fr., so common in the coniferous bogs in Sweden, is recorded by F. H. Møller from Falster, and from Bramminge by Sev. Petersen (loc. cit.), who also mentions *R. nauseosa* (Pers.) and *R. vitellina* (Pers.). Ferdinandsen & Winge (»*Mykologisk Ekskursionsflora*« describe *R. flava* Romell and *R. pectinata* (Bull.) (but this latter may be a synonym of R. simillima).

If all these species be counted, the number of Danish *Russulas* runs up to about 60, a very large figure considering the smallness of the country (most of which is moreover almost unexplored).

To Mr. A. A. Pearson *of Tunbridge Wells, England, I owe a debt of gratitude for having gone over the proof-sheets of this part of my Studies, like the preceding one.*

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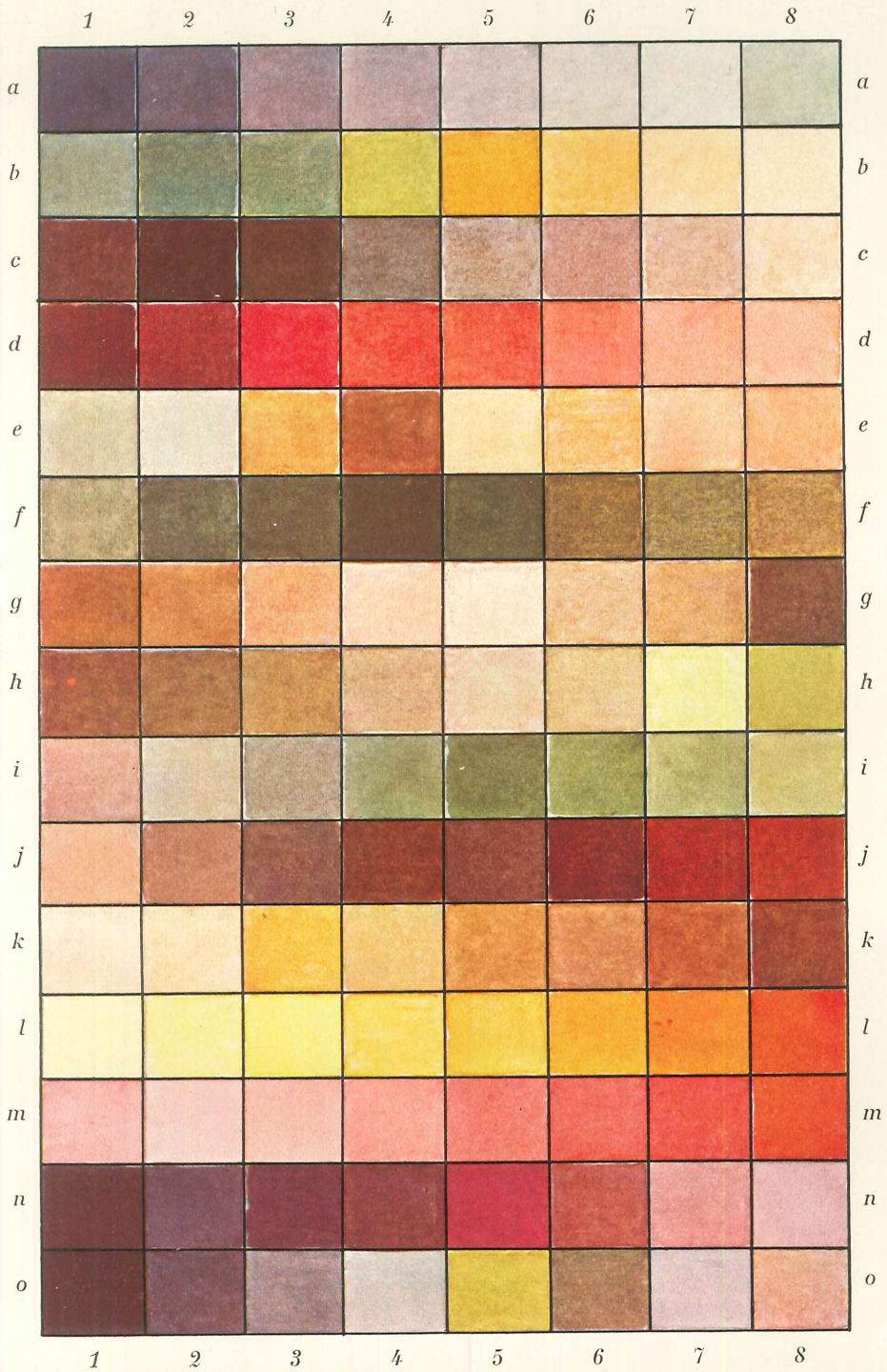

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