

## The Genus *Arcangeliella* CAV. in the Western United States \*)

H. D. THIERS

Department of Biological Sciences, San Francisco State University, San Francisco, CA 94132, USA

### Introduction

The western portion of the United States, especially the Sierra Nevada and Cascade Mountain Ranges, has been shown to support an abundant and diverse secotiid fungus flora (Basidiomycetes, Homobasidiomycetes, Agaricales). The genera *Russula* and *Lactarius* (*Russulaceae*), particularly, are represented by numerous secotiid counterparts that are often collected in both the fall and spring collecting seasons. Related to *Russula* are *Macowanites* and *Elasmomyces* which possess a stipe-columella that may be reduced but even then is usually readily discernible and *Martellia* and *Gymnomyces* which have lost a morphologically distinct stipe-columella although sterile tissue may persist in the gleba cavity which is typically completely enclosed by the peridium during all stages of development. Related to *Lactarius* are *Arcangeliella* in the stipitate-pileate series and *Zelleromyces* in the hypogeous, gastroid series.

The genus *Arcangeliella* was erected by CAVARA from material collected in Italy. A few species have been found in Australia and Thailand, but they are most abundant, so far as it is known, in the western portion of the United States. This paper is devoted to a taxonomic survey of *Arcangeliella* as it is represented in the western United States, especially the states of California and Oregon. Earlier reports have been made by ZELLER & DODGE (9, 10), SINGER & SMITH (4), SMITH (5, 6), THIERS (7) and PEGLER & YOUNG (2).

### *Arcangeliella* CAVARA

Nouv. Giorn. Bot. Ital. N.S. 7: 126. 1900.

*Gastrocarps* stipitate-pileate, subhypogeous to hypogeous or epigeous. — *Pileus* 0.3—8 cm broad, lactarioid, well differentiated, rarely becoming fully expanded, convex to plane or depressed to highly irregular in outline; margin typically attached to stipe, breaking free

\*) This contribution is dedicated to Prof. Dr. M. MOSER, on occasion of his 60th birthday (cf. SYDOWIA 36: 331, 1983).

at maturity or remaining attached during all stages of development; surface dry to moist or subviscid, glabrous to tomentose or fibrillose; colors variable, often white to whitish to yellow to gray or pink to cinnamon, sometimes variegated. — Context white, usually unchanging when exposed. — Taste mild to acrid. — Odor usually not distinctive. — Latex present, white to watery-white, sometimes slowly changing to yellow and staining white paper yellow or darker after twenty-four hours, sometimes staining lamellae brown or reddish. — Gleba lamelliform, lamellae highly branched, intervenose, rarely subparallel in orientation, often not at all or only partially exposed at maturity. — Stipe often greatly reduced, columella percurrent.

Basidiospores ballistosporic, globose to ovoid, with amyloid ornamentations as in Russulaceae, usually with a smooth plage near hilar appendage. — Cystidia usually present, often rare and inconspicuous or differentiated as pseudocystidia or macrocystidia. — Sphaerocysts typically absent in lamellar trama, present but often rare and inconspicuous in pileus trama. — Laticiferous hyphae abundant throughout all tissues. — Epicutis of pileus differentiated as a layer of more or less repent hyphae or as a trichodermium, ixotrichodermium or a turf of free hyphal tips. Clamp connections absent.

Apparently forming ectomycorrhizal associations with a variety of trees, including conifers, in montane and coastal regions.

The concept of this genus, as conceived by SINGER & SMITH (4) and accepted in this paper, includes only those secotioid species which possess a stipe-columella and produce a demonstrable latex. The restriction to those taxa with a latex sometimes creates hardships in making positive generic determinations since, like *Lactarius*, many lose the ability to produce a latex with age. The presence of laticiferous hyphae is not a reliable indicator of the presence of latex because such hyphae are found in practically all members of the Russulaceae, including secotioid and hypogeous species. The latex, so far as it is presently known, is white or watery-white, and usually changes color, if at all, slowly and only slightly. Species with colored latex may exist, however, since a species of *Zelleromyces* was recently collected which had an orange-colored latex. In a recent study PEGLER & YOUNG (2) placed those taxa producing statismospores in the Elasmomycetaceae and retained only ballistosporic species in the Russulaceae. However, evidence gained from the study of western United States material indicates that both spore types may occur in some genera, making this characteristic somewhat unreliable. As a consequence all members of the Astrogastraceous Series are retained in the Russulaceae.

There are two major evolutionary lines in the genus *Arcangeliiella*. One of these, represented by *A. borziana* CAVARA, the type of the genus, along with *A. densa* (HEIM) SINGER & SMITH from Thailand, has basidiospores ornamented with spines and rods, while the other line, represented by American and perhaps Australian species, has spores with either a complete or broken reticulum. Within the group having reticulate spores are two distinct series. One series is characterized by the formation of rather large gastrocarps which are subepigeous or, more typically, epigeous and in which the peridium usually breaks free from the stipe exposing the gleba. This group includes *A. crassa*, *A. desjardinii* and *A. variegata*. The second group, exemplified by *A. saylorii* and *A. parva* produces very small gastrocarps which remain hypogeous throughout their life span, and the peridium characteristically remains attached to the stipe during all stages of development.

### Key to Species

1. Pileus small, rarely more than 3 cm broad; subalpine; hypogeous; peridium not breaking free from stipe, or only slightly so . . . 2
- 1\*. Pileus 5 cm or more broad; subalpine or coastal; subepigeous to epigeous; peridium typically breaking free from stipe at maturity . . . . . 3
2. Basidiospores  $5.5-8.2 \times 5-5.8 \mu\text{m}$ ; pileus rarely more than 1 cm broad, pinkish to orange-pink or pinkish brown . . . 4 *A. saylorii*
- 2\*. Basidiospores  $7.5-9.6 \times 5.5-7 \mu\text{m}$ ; pileus up to 3 cm broad, white to pale yellow . . . . . 3. *A. parva*
3. Subalpine; pileus pinkish buff to pinkish cinnamon; stipe often reduced and obscure . . . . . 1. *A. crassa*
- 3\*. Coastal; pileus gray to olive to dark brown; stipe well developed . . 4
4. Pileus olive buff to olive with yellow to yellowish spots; taste acrid; tramal plates not stained by latex . . . . . 5. *A. variegata*
- 4\*. Pileus dark brown to dark olive without yellowish spots; taste mild; tramal plates stained brown to reddish by latex . . . . . 2. *A. desjardinii*

In the following species description all colors in quotations are from RIDGWAY (3) unless another color guide is cited.

1. *Arcangeliiella crassa* SINGER & SMITH, Mem. Torr. Bot. Club 21: 74. 1960 — Pl. 1, fig. 1.

Syn.: *Arcangeliiella tenax* SMITH & WIEBE, Mycologia 55: 422. 1963.

Basidiocarps subepigeous to epigeous, usually epigeous at maturity, lactarioid, with a distinct stipe and percurrent columella. — Pileus 2.5—8 cm broad, convex to plano-convex when young becoming plane to shallowly depressed or unchanging when mature, often

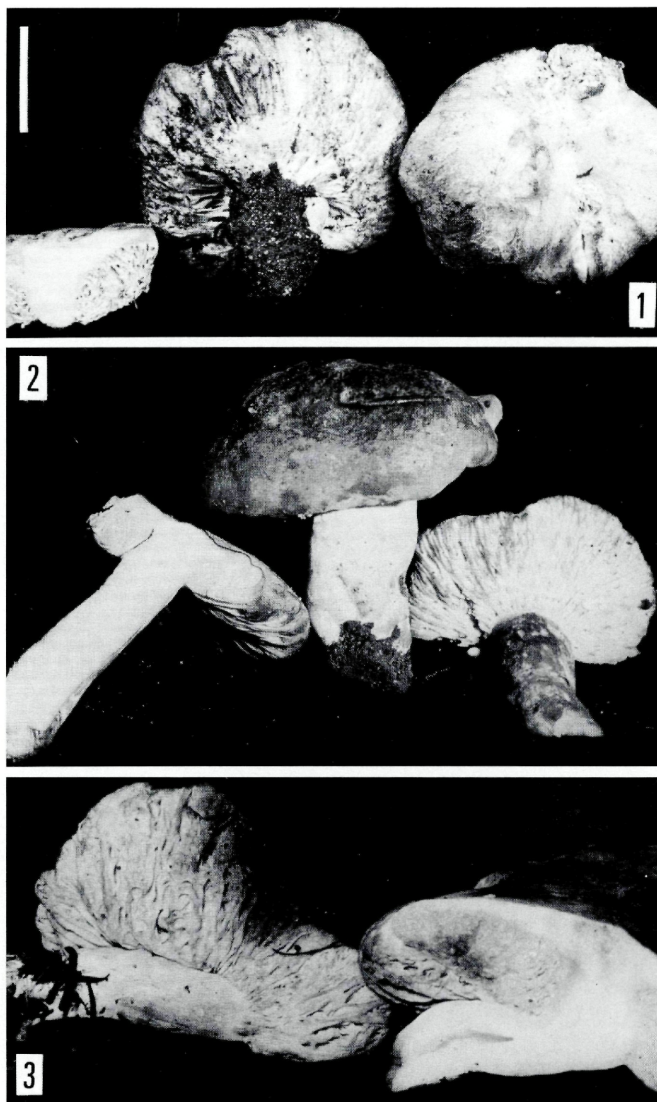


Plate 1. Fig. 1. *Arcangeliella crassa*. — Fig. 2. *Arcangeliella desjardinii*. — Fig. 3. *Arcangeliella variegata*. — (bar = 4 cm, for figs. 1—3).





highly irregular and uneven in outline with age; surface dry to moist or occasionally subviscid, dull, glabrous or obscurely appressed-fibrillose on the disc, colored more or less evenly pink to buff to pinkish brown ("pale pinkish buff" to "pinkish buff" to "pinkish cinnamon"), unchanging or darkening to reddish brown ("cinnamon" to "cinnamon buff") when old, unchanging when bruised. — *Peridium* attached to stipe, at least when young, and sometimes not completely breaking free with age. — *Context* 1–2 cm thick on the disc, thinner toward the margin, firm, white to cream color to pale pink, unchanging upon exposure. — *Taste* immediately and strongly acrid. — *Odor* not distinctive or rather strong and unpleasant. — *Latex* white when first exposed, unchanging or slowly (24–48 hrs.) becoming pale yellow, staining white paper yellow and eventually yellow brown to brown. — *Gleba* (tramal plates) often completely enclosed by the peridium when young, usually becoming exposed when mature, chambered to alveolate, often anastomosed, branched and broadly lacunose; color white very young, typically becoming pale yellow and finally "ochraceous buff" to "pinkish buff", unchanging when bruised. — *Stipe* 0.5–1.5 cm, long, 0.5–1 cm broad, often eccentric, concolorous with the peridium; surface dry, glabrous, solid or hollow at maturity.

*Basidiospores*  $7.5\text{--}10.6 \times 5.5\text{--}8.1 \mu\text{m}$ , ellipsoid, walls hyaline, ornamented with a strongly amyloid, complete or partially broken reticulum, with a rather large, conspicuous smooth plage in the hilar region. — *Basidia*  $35\text{--}47 \times 9\text{--}15 \mu\text{m}$ , 4-spored, clavate, thin-walled. — *Cystidia*  $35\text{--}50 \times 8\text{--}15 \mu\text{m}$ , embedded in the hymenium and often obscure, ventricose to fusoid to subclavate, moderately thick-walled, hyaline in KOH and Melzer's. — *Trama* of glebal plates interwoven, lacking sphaerocysts; laticiferous hyphae present. — *Trama* of pileus interwoven, with numerous conspicuous aggregations of sphaerocysts. — *Epicutis* of pileus composed of a narrow, compact layer of closely appressed, more or less repent, interwoven hyphae which sometimes may be subgelatinous. — *Clamp* connections absent.

*Habit, habitat and distribution.* — *USA:* Originally described from Oregon, this species is the most common taxon in California where it has been most commonly found associated with red fir (*Abies magnifica* A. Murr.) at higher elevations in the Sierra Nevada. It has not yet been found in the coastal areas.

*Arcangeliella crassa* is easily recognized by the large size and the pink to pinkish brown color of the entire basidiocarp, the reduced stipe, the acrid taste and the white to whitish latex which eventually stains white paper yellow then brownish. *A. saylorii* has similar pigmentation but is much smaller, totally hypogeous, has much smaller spores, and the peridial margin does not break free from the

stipe. *A. tenax* is placed in synonymy with *A. crassa* because there is considerable overlapping in the characters used to separate the two species especially in the thickness of the walls of the sphaerocysts, as shown by a study of the holotype of *A. tenax* as well as numerous collections from western North America.

2. *Arcangeliella desjardinii* sp. nov. — Pl. 1, fig. 2

Basidiocarpia stipitato-pileata, epigaea. Pileus 4—5 cm latus, convexus demum planus vel subdepressus, siccus, pruinosis, fuscus vel olivaceus. Contextus albus, immutabilis. Sapor et odor mitis. Latex albus, immutabilis. Gleba lamelliformis, alveolata, subflava vel bubalina, brunneola vel rufa lactice maculata. Stipes 3—4.5 cm longus, 1—1.5 cm latus, siccus, pileo concolor, glaber. Basidiosporae  $7.6\text{--}10.5 \times 6.5\text{--}9.5 \mu\text{m}$ , globosae vel subglobosae, reticulatae vel fracto-reticulatae; reticulum amyloideum. Cystidia  $50\text{--}70 \times 4\text{--}8 \mu\text{m}$ , rara, inconspicua. Epicutis pilei ex hyphis implicatis. Gregaria in solo subter *Pseudotsuga menziesii* (MIRB.) FRANCO. Holotypus: H. D. THIERS 44020 (SFSU), leg. DESJARDIN, 21. Nov. 1981, Jackson State Forest, Mendocino Co., Calif., USA.

Basidiocarps with a distinct, well developed stipe and percurrent columella, epigeous during all stages of development, lactarioid. Pileus 4—5 cm broad, convex when young becoming plane to broadly convex to more typically shallowly depressed at maturity, sometimes with a short, acute umbo on the disc, often uneven and irregular in outline with age; margin incurved, entire or somewhat eroded; surface dry, pruinose, pruina easily removed by rubbing, somewhat wrinkled and often undulating or lobed on the margin, colored dark brown to olive or olive buff or olive brown ("hair brown" to "deep grayish olive"), sometimes paler ("darker olive buff") on the margin, lacking any spots or splotches of yellow discoloration, not changing when bruised. — Context 2—3 mm thick, firm, white, unchanging upon exposure. — Taste mild. — Odor not distinctive. — Latex white, copious, unchanging upon exposure and not staining white paper after 24 hours, typically staining tramal plates brownish to reddish upon drying, taste developing as a tingling sensation on the tongue after a few minutes. — Gleba (tramal plates) usually fully exposed at maturity, irregular in orientation with numerous branches, intervenose, alveolate to broadly lacunose; color pale yellow to buff ("light ochraceous buff") during all stages of development, unchanging when bruised. — Stipe 3—4.5 cm long, 1—1.5 cm broad, equal, solid; context white, unchanging; surface dry, colored as the pileus somewhat paler, often whitish to ochraceous buff at the base, glabrous to tomentose or pruinose at the apex.

Basidiospores  $7.6\text{--}10.5 \times 6.5\text{--}9.5 \mu\text{m}$ , globose to subglobose, walls hyaline with a strongly amyloid, complete or broken reticulum; smooth hilar plage apparent but not strongly conspicuous; apiculus hyaline, well developed, not strongly eccentric. — Basidia

30—50  $\times$  7—8  $\mu$ m, 1—2—4 spored, clavate, hyaline; sterigmata up to 16  $\mu$ m long, curved. — Cystidia 50—70  $\times$  4—8  $\mu$ m, very rare, inconspicuous and embedded in the hymenium, clavate with an elongated tapering apex, walls moderately thin. — Trama of glebal plates interwoven; sphaerocysts absent; laticiferous hyphae abundant. — Trama of pileus composed of interwoven, filamentous hyphae with rare clusters of sphaerocysts; laticiferous hyphae common. — Epicutis of pileus highly differentiated as a layer of tangled (a turf) hyphal tips, ochraceous in Melzer's, pale buff in KOH, individual hyphae hyaline, tips 3—5  $\mu$ m wide. — Clamp connections absent.

Habit, habitat and distribution. — USA: California, Known only from the coastal forest in Mendocino County where it was found growing in soil along a road cut under Douglas Fir (*Pseudotsuga menziesii* (MIRB.) FRANCO. H. D. THIERS 44020 — holotype (SFSU). Collected by Dennis DESJARDIN.

This species is most likely to be confused with *A. variegata* since they both occupy the same type of habitat and both may be somewhat gray to olive in coloration. However, *A. desjardinii* does not have a variegated pileus, lacks an acrid taste, has lamellae (tramal plates) which are stained brownish or reddish by the latex and has a much more highly differentiated epicutis. The epicutis is strongly reminiscent of that of members of Section Plinthogali in the genus *Lactarius*.

### 3. *Arcangeliella parva* sp. nov.

Basidiocarpia stipitato-pileata, hypogaea. Pileus 7—22 mm latus, convexus demum planus vel plano-convexus, humidus, glaber, albidus vel subflavidus, interdum tactu aurantius vel brunneolo-aurantius, margine ad stipitem perpetuo affixus. Contextus albus, immutabilis. Sapor acer. Odor haud distinctus. Latex albus, primo immutabilis dein tarde flavescens. Gleba lamelliformis, locularis vel alveolata, alba. Stipes 5—12 mm longus, 3—6 mm crassus, albus vel subflavidus, siccus, glaber. Basidiosporae 7.5—9.6  $\times$  5.5—7  $\mu$ m, ellipsoideae vel ovoideae, reticulatae vel fracto-reticulatae; reticulum amyloideum. Cystidia 40—56  $\times$  8—12  $\mu$ m, dispersa vel rara, fusioideae; apices longe attenuati. Epicutis pilei intertexta, compacta. In solo subter arboribus coniferis. Holotypus: THIERS 45906 (SFSU), legit DESJARDIN, 14 June 1983, prope Satterly, Plumas Co., California, USA.

Basidiocarp with distinct, although reduced, stipe and percurrent columella, completely hypogaeous during all stages of development, lactarioid. — Pileus 7—22 mm broad, convex when young becoming plane to plano-convex at maturity, margin permanently attached to the stipe and never breaking free to expose the hymenophore; surface moist, not viscid but with debris often remaining attached to the surface, glabrous, colored white to slightly off-white to pale yellow to yellowish white ("cream color"), unchanging or with a tendency to stain grayish orange to brownish orange, drying whitish to brown. —

Context white, 2—3 mm thick, unchanging upon exposure. — Taste strong and immediately acrid. — Odor not distinctive. — Latex white, somewhat watery, not changing immediately when exposed, but after one-half hour or more changing to pale yellow, staining white paper pale yellow after 24 hours and eventually staining it reddish brown to yellow brown. — Gleba (tramal plates) highly crowded, loculate to alveolate, white, unchanging when exposed or bruised, 2—3 mm in depth, completely enclosed by peridium. — Stipe 5—12 mm long, 3—6 mm broad, centrally attached, equal, white to pale yellow ("cream color"); surface dry, glabrous; context white, unchanging when exposed.

Basidiospores  $7.5-9.6 \times 5.5-7 \mu\text{m}$ , ellipsoid to ovoid, walls hyaline, ornamented with a complete or sometimes broken reticulum which is strongly amyloid, ornamentations  $0.25-0.5 \mu\text{m}$  high; plage near hilar appendage smooth or with scattered amyloid particles; apiculus hyaline, up to  $2 \mu\text{m}$  long and  $2 \mu\text{m}$  wide at base. — Basidia  $32-36 \times 10-13 \mu\text{m}$ , clavate, 4-spored, rarely 2-spored; sterigmata short, curved. — Cystidia  $40-56 \times 8-12 \mu\text{m}$ , scattered to rare, hyaline, thin-walled, more or less fusoid with long tapering apices. — Trama of glebal plates composed of filamentous hyphae with no sphaerocysts apparent; laticiferous hyphae abundant. — Trama of pileus interwoven, greatly reduced; sphaerocysts rare to sometimes apparently absent; laticiferous hyphae abundant. — Epicutis of pileus differentiated as a compactly interwoven trichodermium with scattered free hyphal tips, not gelatinous. — Clamp connections absent.

Habit, habitat and distribution. — USA: Hypogeous in soil under conifers (pines and firs). Elevation approximately 5500 feet. Plumas County near Satterly, Calif. 14 June 1983. H. D. Thiers 45906 — holotype (SFSU). Collected by Dennis DESJARDIN.

*Arcangeliella parva* has the same stature as *A. saylorii* and, like *A. saylorii*, is hypogeous with the gleba completely enclosed by the peridium during all stages of development. However, *A. parva* has a white to pallid basidiocarp and much larger spores. It is possible that *A. parva* could be confused with *A. lactarioides* ZELLER which, unfortunately, was described from dried material and, as a result, the nature of the latex, as well as the taste and odor were not recorded. *A. lactarioides* is reported to have feature such as an ixotrichodermium, an appressed fibrillose pileal surface and a gleba which becomes exposed at maturity. None of these characters is seen in *A. parva*.

#### 4. *Arcangeliella saylorii* sp. nov.

Basidiocarpia stipitato-pileata, hypogaea. Pileus 4—7 mm latus, globosus vel convexus demum plano-convexus vel planus, glaber, siccus vel humidus, subaurantius vel aurantio-brunneus, immutabilis, margine ad stipitem per-



petuo affixus. Contextus 1—2.5 mm crassus, subaurantius. Latex albus, immutabilis. Gleba lamelliformis, lacunosa vel alveolata, griseo-aurantia, immutabilis. Stipes 1—3 mm longus, 1—2 mm crassus, siccus, glaber, brunneo-aurantius. Basidiosporae  $5.7\text{--}8.2 \times 4.9\text{--}5.8 \mu\text{m}$ , globosae vel subglobosae, reticulatae vel fracto-reticulatae; reticulum amyloideum. Cystidia  $45\text{--}64 \times 7\text{--}9 \mu\text{m}$ , conspicua, dispersa, clavata vel filiformia. Epicutis pilei ex hyphis filamentosis. Gregaria in solo arenoso et saxoso subter *Abies concolor* (GORD. & GLEND.) LINDL. Holotypus: H. SAYLOR 1571 (SFSU), legit H. SAYLOR, 8 July 1983, China Flat prope Silver Fork Road, El Dorado Co., California, USA.

**Basidiocarps** with well developed stipe and percurrent columella, hypogeous during all stages of development, lactarioid. — **Pileus** 4—7 mm in diam, 2—4 mm high, globose to convex when young becoming plano-convex to near plane with age; margin attached to stipe during all stages of development; surface glabrous, smooth, dry to moist but not viscid, colored pale orange to orange brown (5B3 to 5C4 to as dark as 6C4 — Methuen), unchanging when bruised. — **Context** 1—2.5 mm thick, pale orange (5A3 to 5A4 — Methuen) — **Taste and odor** not recorded. — **Latex** watery white, quickly re-sorbed and easily overlooked, unchanging when exposed, not staining white paper within 24 hours. — **Gleba** (tramal plates) completely enclosed by the peridium during all stages of development, lacunose to alveolate, branched and intervenose, more or less vertically oriented, formed entirely within a space of 1—2 mm in diam, colored grayish orange (5B5 — Methuen), unchanging when bruised. — **Stipe** 1—3 mm long, 1—2 mm broad, very small and reduced, obscure and could be missed unless basidiocarp is sectioned, dry glabrous but covered with debris, colored brownish orange (5C5 — Methuen).

**Basidiospores**  $5.7\text{--}8.2 \times 4.9\text{--}5.8 \mu\text{m}$ , globose to subglobose, walls hyaline, with amyloid ornamentations forming a broken to complete reticulum; hilar plage present and relatively large, frequently with a few very low amyloid granules; apiculus oblique, with no amyloid collar, hyaline. — **Basidia**  $35\text{--}47 \times 7\text{--}10 \mu\text{m}$ , hyaline in KOH, pale yellowish-orange in Melzer's, clavate; sterigmata curved, up to  $3.3 \mu\text{m}$  long and  $1.6 \mu\text{m}$  in diam at the base. — **Cystidia**  $45\text{--}64 \times 7\text{--}9 \mu\text{m}$ , conspicuous, scattered, clavate with long tapered apices with two to four constrictions, or filiform with acute apices, strongly projecting beyond basidia. — **Trama** of glebal plates interwoven; sphaerocysts and laticiferous hyphae not seen. **Trama** of pileus interwoven with numerous nests of sphaerocysts; laticiferous hyphae common. Epicutis of pileus composed of more or less irregularly repent filamentous hyphae, not gelatinous. **Clamp** connections absent.

**Habit, habitat and distribution.** — Hypogeous in gregarious clusters in loose sandy and rocky soil under red fir (*Abies concolor* (GORD. & GLEND.) LINDL.) in mixed coniferous forest. China Flat near Silver Fork road, El Dorado County, California. H. SAYLOR 1571 — holotype (SFSU).

This species is recognized by its very small size, completely hypogaeous habitat and orange to orange brown colors. So far as can be determined it has the smallest basidiospores of all species yet encountered. The color of the basidiocarp is suggestive of *Arcangeliiella crassa*, but that species is much larger, is at least subepigeous and has larger spores. *A. parva*, which also produces small basidiocarps, has a yellowish colored pileus and larger spores.

5. *Arcangeliiella variegata* THIERS, Sydowia, Beih. 8: 383. 1979. — Pl. 1, fig. 3

Basidiocarps with distinct, well developed stipe and percurrent columella, epigeous, lactarioid. — Pileus 4–8 cm broad, convex to planoconvex to plane, occasionally becoming shallowly depressed to highly irregular to undulating in outline with age; margin typically incurved, entire; surface moist to dry, dull, glabrous to somewhat velutinous, colored olive buff (“pale olive buff” to “olive buff”) when young, usually unchanging with age, but frequently developing yellow to pale yellow spots or splodges with age, unchanging when bruised. — Context 2–4 mm thick, white, unchanging upon exposure. — Taste distinctly acid. — Odor mild. — Latex copious, white to whitish or sometimes almost clear, unchanging upon exposure, not staining gleba or context, not staining white paper after twenty- four hours. — Gleba (tramal plates) highly alveolate and irregular in orientation, typically branched and intervenose, colored near buff to pink (“pinkish buff” to “pale ochraceous buff”), unchanging when bruised, typically exposed during all stages of development. — Stipe 3–5 cm long, 2–4 cm broad at the apex, more or less equal; surface dry, glabrous, white, staining brown when bruised. Context white, unchanging when exposed.

Basidiospores  $8.4\text{--}9.6 \times 7.8\text{--}9.0 \mu\text{m}$ , globose to subglobose, walls hyaline, ornamented with a broken or complete, well formed reticulum, ornamentations strongly amyloid, with a smooth plage near the hilar appendage. — Basidia  $30\text{--}37 \times 10\text{--}15 \mu\text{m}$ , 2–4 spored, hyaline, clavate; sterigmata strongly developed. — Cystidia  $35\text{--}40 \times 13\text{--}17 \mu\text{m}$ , rare, deeply embedded in the hymenium, inconspicuous hyaline, thin-walled, clavate to subfusoid to obscurely fusoid-ventricose. — Trama of glebal plates with a distinct central mediostrium, hyphae subparallel; sphaerocysts absent; laticiferous hyphae abundant. — Trama of pileus interwoven, with scattered sphaerocysts and laticiferous hyphae. — Epicutis of pileus composed of compactly interwoven, non-gelatinous, filamentous hyphae. Hypodermis composed of loosely interwoven, filamentous hyphae; sphaerocysts rare. — Clamp connections absent.

**Habit, habitat and distribution.** — **USA:** Gregarious to scattered in soil or humus of mixed coastal forests of northern California.

The color of *Arcangeliella variegata* is typically strongly developed in young basidiocarps but may fade with age. The yellow spots or splodges may become rather prominent and noticeable as the pilei mature, or they may always remain small and inconspicuous. *A. desjardinii* which is most closely related to *A. variegata* does not show the spots or splodges of yellowish discoloration and does not have an acrid taste. The staining reaction on the tramal plates which is typically observed in *A. desjardinii* does not occur in *A. variegata*. The two species also differ in the type of epicutis. *Arcangeliella crassa*, like *A. variegata*, has a large epigeous basidiocarp, but the pileus is pinkish to cinnamon in color, the stipe is often considerably reduced, and the tramal plates are typically enclosed, at least when young. *A. crassa* has been found only in the mountain ranges of the state, while *A. variegata* and *A. desjardinii* are known only from the coastal areas.

### Excluded Species

*Arangeliella lactarioides* ZELLER, Mycologia 39: 282. 1947.

„Gastrocarp 25—30 mm broad, 15—20 mm high, subspherical becoming expanded, summit slightly depressed; peridium smooth, innately fibrillose, dry, pale yellowish, drying brownish, context thin especially below or at the margin where it breaks away from the stipe-columella; columella percurrent, 4—6 mm broad, laticiferous hyphae present, „lactiferous“ (ZELLER); gleba white, becoming creamy, drying brownish, exposed below, adnexed, very ventricose cavities labyrinthiform, partly filled with spores.

„Spores 8—11 × 6—7  $\mu$ , ellipsoid, rather thin-walled, ornamentation in the form of a strongly amyloseous reticulum 0.3—0.5  $\mu$  high; plage area nearly smooth, sterigmal appendage short-pointed.

„Hymenium. Basidia 4-spored, 40—48 × 9—12  $\mu$ , clavate, sterigma 3—4 × 1  $\mu$ , very short and conic; cystidia present as ends of laticiferous hyphae projecting into the hymenium (pseudocystidia).

„Hyphal layers. Subhymenium cellular; true laticiferous hyphae abundant in tramal plates; remainder of elements in mediostrium filamentous and interwoven and with scattered sphaerocysts through this matrix. Peridium of heteromerous tissue; the epicutis a gelatinous layer with some dermatocystidia present in it but not reviving too well at the surface. Clamp connections none.

„In the fir woods below timberline (elev. 7500 ft.), Diller Canyon, Mt. Shasta, Calif. (COOKE 14666, type) (NY).

„Material studied. Wm. B. COOKE 14666 (type).

„As Zeller stated 'This species is a clear connecting link between the *Gastromycetes* and *Lactarius*'. It is even closer to *Lactarius* than is *A. borziana*, as indicated by the reticulum of the spores.“

The description given above was taken from SINGER & SMITH (4). Unfortunately it seems necessary to place this species in the excluded list because of the inadequacy of the description of the type collection.

Present day concepts place a great deal of emphasis on the nature of the latex such as its color when first exposed, any color changes following exposure, staining reactions, if any, upon tissues of the basidiocarps and color changes on white paper. Since these data are not available it is impossible to make proper disposition of this taxon. It would have been helpful also if information on taste and odor had been available.

As indicated under *Arcangeliella parva*, these two species appear to be closely related. *A. lactarioides*, according to ZELLER (8) and SINGER & SMITH (4) has a gelatinous epicutis and the margin of the pileus breaks free from the stipe exposing the gleba whereas in *A. parva* the cuticle is not gelatinous and the gleba is never exposed. The surface of the peridium is described as innately fibrillose in *A. lactarioides* and as glabrous in *A. parva*. Furthermore, no staining reactions of the pileus upon bruising were recorded for *A. lactarioides*. The fact remains, however, that the two species appear similar in many ways and could conceivably be conspecific, but until more data are available regarding *A. lactarioides* it must be regarded as an excluded species.

*Arcangeliella camphorata* (SINGER & SMITH) PEGLER & YOUNG, Trans. Brit. Myc. 72: 365. 1979.

This species was originally described as *Elasmomyces camphorata* because the authors were unable to demonstrate the presence of a latex. PEGLER & YOUNG transferred it to *Arcangeliella* on the basis of the absence of sphaerocysts in the trama of the glebal plates, the exposure of the gleba at maturity and the geotropically oriented glebal chambers. They saw no fresh material and thus did not demonstrate the presence of a latex. Until such time as a latex is found, this taxon should remain in *Elasmomyces*.

*Arcangeliella alveolata* (COOKE & MASSEE) ZELLER & DODGE, Ann. Mo. Bot. Gard. 22: 365. 1935

= *Martellia alveolata* (COOKE & MASSEE) A. H. SMITH, Mycologia 54: 630. 1962.

*Arcangeliella ambigua* ZELLER & DODGE, Ann. Mo. Bot. Gard. 22: 365. 1935.

= *Chamonixia* sp.

*Arcangeliella behrii* and *A. behrii* var. *caudata* ZELLER & DODGE, Ann. Mo. Bot. Gard. 22: 366. 1935

= *Chamonixia* sp.

*Arcangeliella cremea* ZELLER & DODGE, Ann. Mo. Bot. Gard. 22: 367. 1935

= *Martellia cremea* (ZELLER & DODGE) SINGER & SMITH, Mem. Torr. Bot. Club 21: 45. 1960.

- Arcangeliiella gardneri* (ZELLER & DODGE) ZELLER & DODGE, Ann. Mo. Bot. Gard. 22: 367. 1935  
 = *Zelleromyces gardneri* (ZELLER & DODGE) SINGER & SMITH, Mem. Torr. Bot. Club 21: 23. 1960.
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