

## *Scleroderma citrinum* Pers. AEB 1308 (= PDD 117246)

**Collection site:** Wainuiomata Recreation Area, Nikau Track – arrowed below [on soil beside the track which was lined with large specimens of the tree species Kanuka (*Kunzea* sp.), suspected in this case of being an ectomycorrhizal associate of *Scleroderma citrinum*].



**Collection dates:** 15 & 18 February 2018 (15<sup>th</sup> only 2 specimens which were opening apically to expose the glebal mass, 18<sup>th</sup> several small and larger unopened specimens for sectioning & photography).

**Collector & identifier:** Dan Mahoney

**Voucher materials:** Dried herbarium specimens AEB 1308 (= PDD 117246) – the 2 apically-opened basidiomata collected on 15 Feb. and several unopened whole and longitudinally sectioned basidiomata collected on 18 Feb. – and a Shear's mounting fluid (SMF)/aniline blue lactic acid heated semi-permanent slide mount; a number of scanned 35 mm Kodak 400 ASA film photos of whole and sectioned basidiomata and a number of compound scope digital photos from reasonably concentrated NaOH and SMF/aniline blue lactic acid microscope slides; Dan's description and comments.

**Publications and websites consulted:**

**General with keys**

- 1) Nouhra E.R., Hernández-Caffot M.L., Pastor N. & Crespo E.M. 2012. The species of *Scleroderma* from Argentina, including a new species from the *Nothofagus* forest. *Mycologia* 104: 488–495.
- 2) Sims K.P., Watling R. & Jeffries P. 1995. A revised key of the genus *Scleroderma*. *Mycotaxon* 56: 403–420.
- 3) Guzmán G., Cortés-Pérez A., Guzmán-Dávalos L., Ramírez-Guillén F. & Sánchez-Jácome M.D.R. 2013. An emendation of *Scleroderma*, new records, and review of the known species in Mexico. *Rev. Mex. Biodivers.* 84: S173–S191.

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4) Kuo M. 2004. *Scleroderma citrinum*. Retrieved from the *MushroomExpert.Com* Web site:

[http://www.mushroomexpert.com/scleroderma\\_citrinum.html](http://www.mushroomexpert.com/scleroderma_citrinum.html)

5) Trial field key to the species of SCLERODERMATACEAE in the Pacific Northwest.rtf

**Specific – 1) *Scleroderma citrinum* or its synonyms *S. aurantium* & *S. vulgare*, 2) *S. bovista* not included in key**

6) Online at: *Scleroderma citrinum* - Messiah College

*Scleroderma citrinum*. Scientific name: *Scleroderma citrinum* Persoon Derivation of name: Citrin- means "lemon-yellow."

Synonyms: *S. aurantium* (L.) Pers.; *S. vulgare* Hornem. Common name(s): Common earthball; Golden *Scleroderma*; Pig-skin poison puffball. Phylum: Basidiomycota Order: Boletales

7) Online at: [Scléroderme vulgaire - \*Scleroderma citrinum\* - Champignons de Gaume www.champigaume.be/files/Scleroderma-citrinum.666.pdf](http://www.champigaume.be/files/Scleroderma-citrinum.666.pdf)

8) [VIRTUAL MYCOTA: NZ Fungi Identification: \*Scleroderma aurantium\* https://virtualmycota.landcareresearch.co.nz/webforms/vM\\_Species\\_Details.aspx?pk...](https://virtualmycota.landcareresearch.co.nz/webforms/vM_Species_Details.aspx?pk...)

Article: Gadgil, P.D. (in association with Dick, M.A.; Hood, I.A.; Pennycook, S.R.) (2005). Fungi on trees and shrubs in *New Zealand. Fungi of New Zealand. Ngā Harore o Aotearoa* 4: xi + 437 p. Hong Kong: Fungal Diversity Press. Description: Type: Mycorrhizal Fungi; Description: Basidiomata depressed globose, yellowish, ...

## Sequencing

1) Zhang C., Xu X-E., Liu J., He M., Wang W., Wang Y. & Ji K. 2013. *Scleroderma yunnanense*, a new species from South China. *Mycotaxon* 125: 193–200.

2) Rusevska K., Karadelev M., Phosri C., Dueñas M., Watling R. & Martín MP. 2014. Rechecking of the genus *Scleroderma* (Gasteromycetes) from Macedonia using barcoding approach. *Turkish Journal of Botany* 38: 375–385.

3) Mrak T., Kühdorf K., Grebenc T., Štraus I. & Münzenberger B. 2017. *Scleroderma areolatum* ectomycorrhiza on *Fagus sylvatica* L. *Mycorrhiza* 27: 283–293.

**Description:** **Basidiomata** separate or aggregated, firm, leathery, epigeal on the soil except for a sizeable hypogean mass of rhizoidal hyphae. All observed (except two) were closed with a blackish (or purplish-black) **glebal mass** occupying most of the fruiting body (as viewed in central longitudinal section). Unsectioned whole views were globose to somewhat ellipsoidal, 2.5–7 cm in greatest mid x-section diam. The **peridium exterior** with numerous, prominent brownish scales interrupted by yellowish to yellowish-brown spaces in the uppermost and side regions (smoother below). Prominent scales (actually raised brown portions of the peridium or flattened warts rather than what I think of as ‘scales’) irregularly squarish to rectangular, 1–2+ mm in narrowest diameter and often with an extension at one end (“squarrose” according to Guzmán et al., 2013).

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These scales sometimes seen in rosettes with a central scale surrounded by other scales and these surrounded by a circle of scales. However, unless I was looking for rosettes, these were not always obvious. **Peridium interior** as seen prior to basidioma dehiscence (in central longitudinal sections) narrow (roughly 1–2 mm wide), white and occasionally a faint reddish next to the gleba; the basal extension (below the gleba and just above the hypogean rhizoidal mass) much larger, at first white but then with faint reddish areas or bands). The aforementioned reddish coloration resulted without the addition of KOH. Unfortunately, I had only a concentrated NaOH available and its application resulted in brown rather than the red changes reported after KOH applications. In fact, the NaOH turned reddish areas brown. The peridium in the 2 dehiscent specimens folded irregularly or somewhat stellately away from cracks at the apex of the basidioma and then were yellow rather than white in cross section. Also yellowish in opened and closed basidiomata were many of the glebal trama and many of the basal rhizoidal threads. The latter (trama & rhizoids) are often reported as white elsewhere). Worth noting is a separation in the peridium of the two opening basidiomata. The folding portion represented most of the peridium but a very thin innermost portion still remained over the now (nearly exposed) mature glebal mass. Other reports don't describe or illustrate this thin innermost portion. The mature exposed glebal mass was powdery dark brownish.

**Basidiospores** were globose, (11–)12–14(–15)  $\mu\text{m}$ , dark brown, distinctly spiny and reticulate to subreticulate. Clear observations of the surface reticulum required careful focusing, exposure correction and enlargements beyond those available under the X100 objective lens. The spines, rising above the reticulum, were 1–2  $\mu\text{m}$  long and more easily observed at a spore mid-section focus.

**The New Zealand 'Systematics Collection Data':** PDD online (24 Sept. 2020) records 360 collections of *Scleroderma*. Roughly 300 of these are labelled *Scleroderma* sp. (121), *S. cepa* (including its synonym *S. flavidum*) (83), *Gallacea scleroderma* (55) and *S. bovista* (40). *Scleroderma citrinum* records include only 3 from NZ (one of which is listed as *S. bovista* PDD 95879).

**Comments:** My primary source in identifying collections AEB 1308 & 1309 was that in Guzmán et al. (2013). There, *Scleroderma citrinum* & *S. bovista* are separated primarily by basidiospore and basidioma peridium differences:

Exoperidium smooth to finely warty, whitish or yellowish-brown, with minute dark scales. Basidiospores with a uniform and thick reticulum.....*S. bovista*

Exoperidium thick, coarsely scaly, scales in rosette in the apex or on the sides, yellowish to orange-yellowish. Basidiospores with a not uniform but thick reticulum .....*S. citrinum*

Basidiomata for 1308 & 1309 are more clearly those of *S. citrinum* while the spore reticulum could be either species. Are these species imported to NZ (probably) and if so, from where? Both are ectomycorrhizal and have many N. Hemisphere records, esp. in the E. United States and Europe with *S. citrinum* most common in Europe (see **GBIF Backbone Taxonomy**). Ectomycorrhizal sequencing (Mrak et al. 2017) suggests a close relationship between species. More morphological and ecological work is required to further distinguish them.

Guzmán G., Cortés-Pérez A., Guzmán-Dávalos L., Ramírez-Guillén F. & Sánchez-Jácome M.D.R. 2013. An emendation of *Scleroderma*, new records, and review of the known species in Mexico. Rev. Mex. Biodivers. 84: S173–S191.

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***Scleroderma citrinum*** Pers., *Syn. Meth. Fung.* 1: 153, 1801.

= *Scleroderma vulgare* Hornem., *Syst. Mycol. (Lundae)* 3: 46, 1829.

= *Pompholyx sapidum* Corda, in Sturm, *Deut. Crypt. Fl.* 10-20: 47, 1841.

Figs. 10, 35-37

Basidiome (20-) 40-80 (-100) mm diam., globose to ovoid, often apically flattened, sessile or shortly substipitate, with a compact mycelial base. Peridium 2-5 mm thick, tough, yellowish-brown to pale orangish-yellow, coarsely scaly, the scales frequently in rosette on the upper part or on the sides, also imbricate and squarrose on the sides, the exoperidium in the base of the basidiome and in the upper part of the pseudostipe breaks in submembranaceous or collapsed fragments, like patches, concolor to blackish, due to the lysing of the hyphae. Endoperidium whitish to yellowish, rubescent when cut. Dehiscence through an irregular apical breaking or substelliform, finishing as an irregular cup-like fruit body. Gleba white to dark vinaceous or purplish, compact, then dusty. Taste and odor like rubber. Basidiospores (9-) (10-) 11-14 (-17)  $\mu\text{m}$  diam., subreticulated to reticulated, reticulum 1-2.5  $\mu\text{m}$  high. Basidia 14-30 x 7.5-10  $\mu\text{m}$ , pyriform, thin-walled, hyaline, 2-4 (-6) sterigmata. Oleiferous hyphae present in both exo- and endoperidium. Clamp connections present.

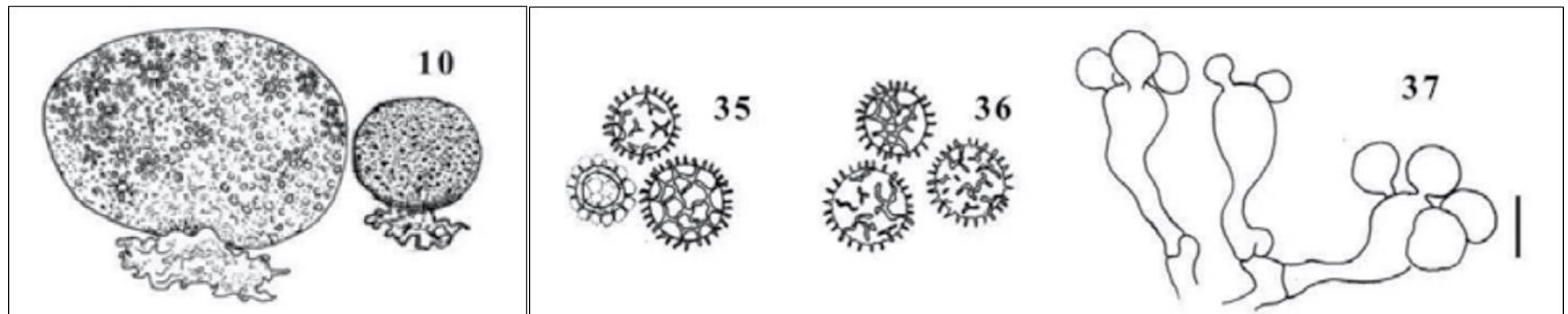
#### *Taxonomic summary*

*Habitat and distribution.* Gregarious or caespitose, epigeous on soil or humus with mosses, sometimes on rotten wood. Common in coniferous forest or in *Pinus-Quercus* forests. See in table 1 its distribution in Mexico. The collections from Jalisco and Veracruz are the first records from these states.

*Selected studied specimens.* Jalisco, Tapalpa, Sept. 3, 1978, *García-Saucedo s.n.* (IBUG). Veracruz, Huayacocotla road to Viborillas, SE of Huayacocotla, Sept. 14, 2009, *Cortés-Pérez 170, 175*; Aug. 6, 2010, *Cortés-Pérez 303* (all in XAL).

*Remarks.* *Scleroderma citrinum* is one of the most common species in Europe, but infrequent in Mexico.

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***Scleroderma citrinum*.** Side views of 2 closely associated basidiomata. Note the abundance of brownish scales separated by yellow areas. These are larger in the upper region of the fruiting bodies and smaller, or almost absent, in the lower region. Note also the hypogean rhizoidal/soil clump at the base of each basidioma. The basidiomata seen here are the only 2, among many seen along the Nikau Track, which were opening apically (irregularly or somewhat stellately) to expose the mature glebal mass.



The same two basidiomata seen on the previous page but here shown in an overhead view and left-to-right reversal.



**A reorientation of the right-hand basidioma from the previous page (mid x-section widths – 6 cm at the widest point, 5 cm at the narrowest). Note the powdery brown glebal interior (white arrow) where apical splitting of the peridium has occurred. Note, also, that most of the leathery peridium (left black arrow) is folding away after its apical splitting, but its very thin innermost portion (right black arrow) – though split to expose the gleba – is still providing a protective cover.**



A reorientation closeup of the smaller left-hand basidioma from the page before last (mid x-section diameter 4 cm). Note the same features emphasized on the previous page for the larger adjacent basidioma, but also the more stelliform splitting of the peridium.





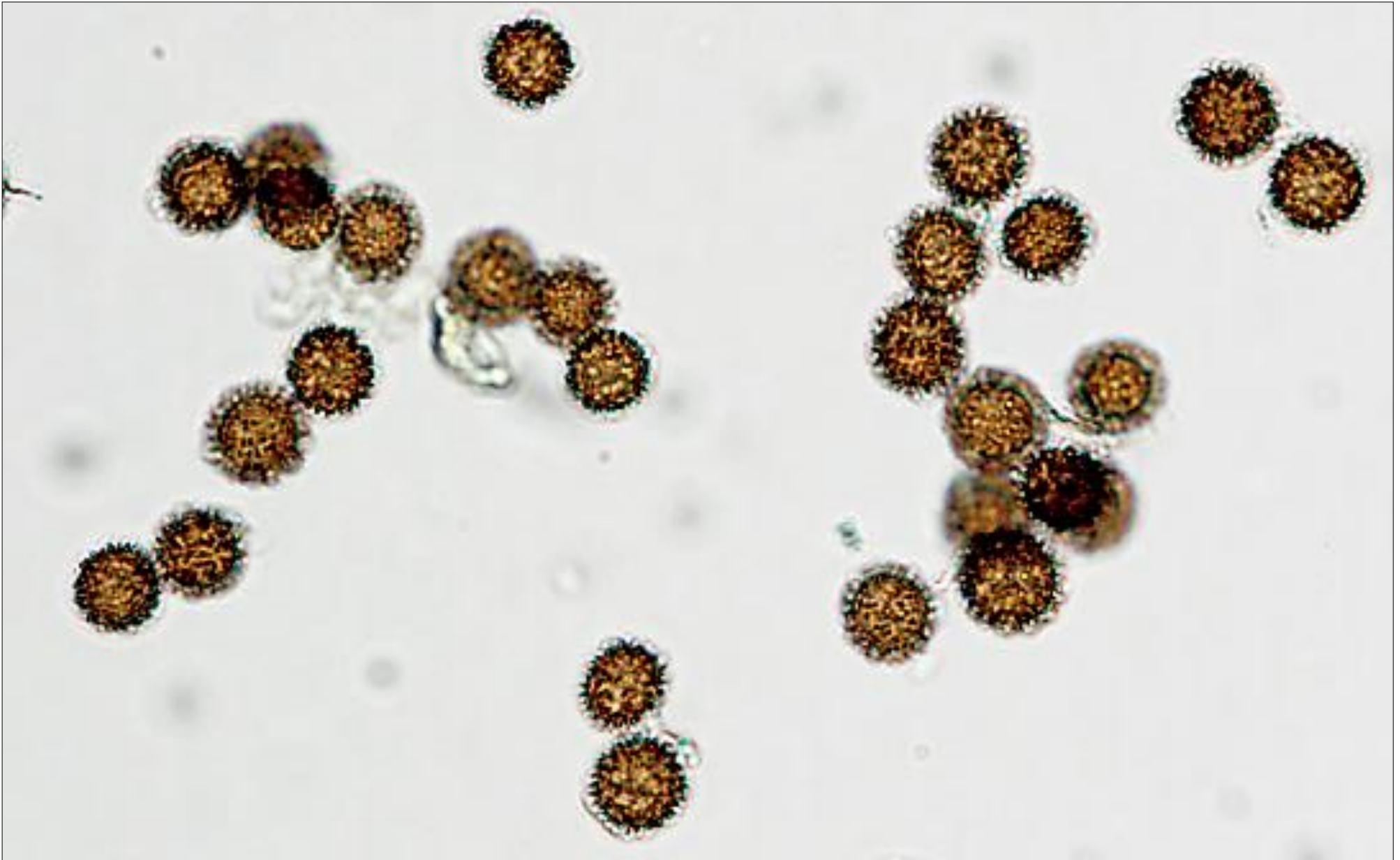
Side view (left) and overhead view (right) of the same basidioma (mid x-section diameter 6 cm). Note the large hypogean rhizoidal/soil mass (side view) and the early peridial cracking at the basidioma apex (overhead view). The ringed insert illustrates the rosette-like arrangement of flattened scales - less obvious here than on some other basidiomata.



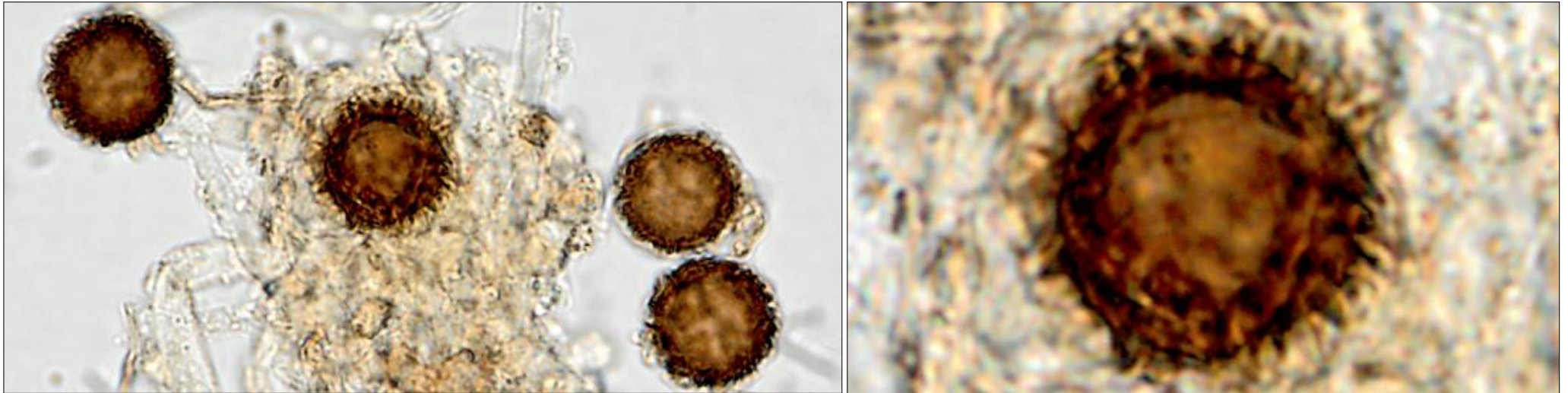
**A central longitudinal section of the fresh basidioma on the previous page. Reddish 'bruising' in the innermost peridium along the sides of the gleba isn't obvious here and likewise in the larger whitish area below the gleba. The coloration of the glebal mass seemed to depend in part on the lighting (in this case bright sunlight). My Nikon film scanner read this as more violet-purple than my eye view BUT my color editing has removed too much of the violet-purple, leaving the present view more dark brown rather than the somewhat violet-purple blackish view that I saw.**



**Another photo of 2 adjacent basidiomata in whole and longitudinal section side views (2.5 & 5 cm in mid x-section diameter).**



**Basidiospores from the glebal mass of an unopened, longitudinally-sectioned specimen (6 cm diameter). Mounted in SMF/aniline blue lactic acid (heated) & photographed under the X40 objective. Observations from dehiscent basidiomata under the X100 objective are required to ensure spore maturity and ornamentation clarity.**



**Basidiospore photography from the exposed gleba of one of the only 2 fully mature and dehiscent specimens seen along the Nikau Track. Spores mounted in concentrated NaOH & photographed under the X100 objective. The middle spore in median focus (14  $\mu\text{m}$  diameter) emphasizes the 1–2  $\mu\text{m}$  long spines. The left-hand photo represents the unenlarged spores; the right-hand photo an enlarged spore. A view of the spore reticulum requires more careful focusing on the uppermost surface (see the next page).**

**Basidiospore photography from the same mounts and under the same X100 objective as on the previous page. Here, the focus on the uppermost surface enables a view of the reticulate ornamentation. The lower right photo inset represents an unenlarged X100 objective view but the enlarged view enables a clearer view of the reticulum.**

