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REPOSITORIES OF SYMBIOTIC FUNGUS IN THE AMBROSIA BEETLE
***Monarthrum scutellare* LEC. (COLEOPTERA:SCOLYTIDAE)**

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Introduction

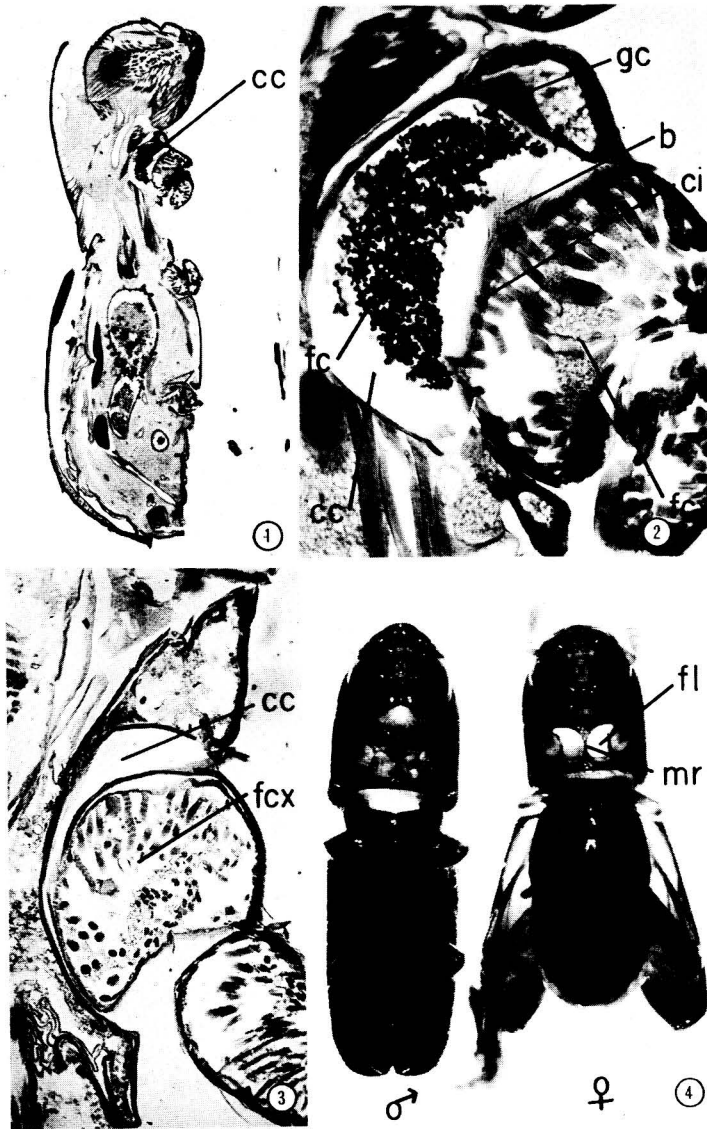
Specialized structures or mycangia that contain symbiotic fungi have been identified by several workers in a number of scolytid ambrosia beetles. Since Francke - Grosmann (1956a) first described structures with this function in *Trypodendron lineatum* Oliv., workers have reported mycangia in other species (Francke - Grosmann, 1956b, 1958; Fernando, 1960; Schedl, 1962; Finnegan, 1963; Farris, 1963; Batra, 1963). Only females of most species possess these structures but in *Corthylus punctatissimus* Zimm. (Finnegan, 1963), *Gnathotrichus retusus* Lec., and *G. sulcatus* Lec. (Farris, 1963) only males have mycangia.

Batra (1963), working with *Monarthrum faciatum* Say and *M. mali* Fitch found mycangia to be enlargements of the forecoxal cavities in the female beetles. Because of this and the previous work of Francke-Grosmann and Batra (Francke-Gros-

mann, 1963) with these two species of *Monarthrum* it seemed reasonable to suspect that *Monarthrum scutellare* Lec. would possess mycangia in a similar position. This insect attacks logs or weakened trees of the genus *Quercus* from British Columbia south to California (Chamberlin, 1958), its host on Vancouver Island being *Q. garryana* Dougl.

Materials and Methods

Adult beetles were excavated from their host and either kill-fixed in alcoholic Bouin's solution for sectioning or stored alive in a refrigerator for dissecting and culturing later. Specimens for sectioning were dehydrated with tertiary butyl alcohol (Johansen, 1940), embedded with Fisher's "Tissuemat," and serial sagittal sections were cut at 15 and 20 microns on a rotary microtome. The sections were treated with a modified Gram-Weigert stain (Leach, 1940) and counter stained with eosin Y, previously used by Fernando (1960),



Illustrations

- Fig. 1.—Sagittal section, 15 microns, of a whole ♀ *M. scutellare* stained with a modified Gram-Weigert stain, showing the location (cc) of the mycangia. 22X.
- Fig. 2.—Sagittal section, 20 microns, of the enlarged ♀ forecoxal cavity (cc), stained with a modified Gram-Weigert stain to show the fungous cells (fc), glandular tissue (gc), brush (b) and coxal indentation (ci). 180X.
- Fig. 3.—Sagittal section, 15 microns, of a ♂ coxal cavity (cc). 180X.
- Fig. 4.—Ventral view of ♂ and ♀ *M. scutellare* adults with forecoxae removed to show whitish fungous layer (fl) and complete median ridge in ♀ (mr), and the lack of same in ♂. 20X.

Symbol Legend

- | | |
|-------------------|-----------------------|
| cc —Coxal cavity | ci —Coxal indentation |
| fl —Fungous layer | fc —Fungous cells |
| gc —Gland cells | mr —Median ridge |
| b —Brush | fcx—Forecoxae |

Farris (1963) and Farris and Funk (1965), to differentiate fungous deposits from other tissue in beetle sections.

To corroborate findings in the stained sections, the forecoxae were removed from refrigerated beetles of both sexes and the coxal cavities examined under a dissecting microscope. Cultures were made from the cavity contents and the fungus identified as *Monilia brunnea* Verrall (Funk, 1965).

Results and Discussion

Stained sagittal sections of female beetles showed enlargements of the forecoxal cavities (Figs. 1 and 2) containing blue and pink coloured fungous material consisting of globose cells and short hyphal filaments (Fig. 2). The male forecoxal cavities were not enlarged (Fig. 3) and did not contain fungous material. The mesocoxal and metacoxal cavities of both sexes were not enlarged and likewise contained no fungous material. A whitish layer of fungous material was visible when the forecoxae of the female were removed from their sockets. This was absent in the male (Fig. 4).

After staining with the modified Gram-Weigert stain and eosin Y, some of the globose fungal cells found in the forecoxal cavities showed a Gram-positive reaction by retaining the blue stain, and others showed a Gram-negative reaction by turning pink. When these cells were viewed under polarized light, a portion of the walls of the Gram-positive cells was birefringent but no birefringence was seen in the Gram-negative cells. The significance of the birefringence is unknown. Fresh fungous material taken from the coxal cavities showed no birefringence.

The median ridge between the forecoxal cavities of the female is complete, forming part of the my-

cangial wall (Fig. 4) separating the two cavities. This ridge is incomplete in the male (Fig. 4).

The fungous cells are not contained in a structure with a separate specialized opening as in *T. lineatum*, but lie in a loosely compressed hemispherical cake in the cavity (Fig. 2).

Within the anterior wall of the cavity in the female there is a series of gland cells which appear to lead into the cavity (Fig. 2), but these are absent or greatly reduced in the male. In her work with several species of ambrosia beetles Francke-Grosmann suggested that secretions from similar cells are beneficial to the fungous spores. Possibly the gland cells serve a similar function in *M. scutellare*.

Not only are the female cavities enlarged, making a place for fungus transport, but the forecoxae have a slight indentation which makes the cavity even larger (Fig. 2). At the anterior edge of this indentation, opposite the glandular tissue, there arises a sclerotized group of bristles forming a brush (Fig. 2). The bristles are pointed or bent away from the main body of fungous cells. The orientation of the brush on the coxae indicates that it could move the fungous cells forward and out of the cavity when the beetle walks about in its gallery, thus inoculating the host with the fungus.

Schedl (1962) has described similar mycangia and methods of host inoculation in the ambrosia beetles *Pterocyclon brasiliensis* Schedl and *P. nudum* Schedl, both from Brazil.

Summary

Adult female beetles of *Monarthrum scutellare* Lec. carry symbiotic fungi in mycangia. These are enlargements of the forecoxal cavities similar to those described by Batra (1963) for other members of the genus. Male beetles do not have these structures.

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