

## New species of parasitic fungi occurring on mites (Acarina)

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The authors describe three new fungi, external parasites of mites occurring in galleries of bark beetles: *Thaxteriola moseri*, *Acariniola subbasalipunctata* and *A. basalipunctata*. The last two have been included in a new genus *Acariniola*, differing from other representatives of the group *Thaxteriolae* by a smaller number of cells constituting the thallus (only two) and a penetration pore separated from the foot.

In the years 1973-1975 throughout Poland investigations were performed on acarofauna occurring in galleries of bark beetles (*Scolytidae*) in various forest associations. On many species of mites spores of various fungi were observed transferred mechanically (Balazy et al. 1977) and also small presumably parasitic fungi. They were found on mites from various taxonomic groups (*Gamasina*, *Uropodina* and *Acaroidea*) in various amounts — from single specimens to about 300 thalli on one individual, both on juvenile forms and on adults. No distinct specialization of these organisms on certain parts of the body of the hosts were observed. They were found both on the dorsal and ventral plate as well as on the legs and gnathosoma, however they are more common and occur in greater numbers on the legs, especially on the tibiae and tarsi.

The identification of these organisms encountered serious difficulties. In the available literature no mention of these organisms nor any description was found. They are relatively most similar to fungi with an undefined taxonomic position (*incertae sedis*) included in the group "*Thaxteriolae*". This name was used by Thaxter (1920) to describe the fungi with a similar, very simple structure even though probably unrelated to each other.

This group includes the genera *Thaxteriola* Speg., *Endosporella* Thaxter, *Laboulbeniopsis* Thaxter and *Coreomycetopsis* Thaxter, and possibly *Entomocosma* Speg. (Kimbrough, Gouger 1970). These genera and the species belonging to them were described in the works of Spegazzini (1918) and Thaxter (1920). All are characterized by a thallus composed of three or more (up to 15) cells lying in one row. The basal one is attached by a dark foot to the surface of the host, in the terminal cells (sporogonium) unicellular spores are formed which are liberated by a hole at the top of the cell. They are external parasites of arthropods of the genera *Labia*, *Philonthus* and *Belonuchus* (*Thaxteriola infuscata* Speg.), *Aphodius* (*Thaxteriola subhyalina* Speg.), undefined *Staphylinidae* (*Thaxteriola nigromarginata* Thaxter and a specimen drawn by Thaxter, 1914 fig. 30 not described further), *Diopsis* (*Endosporella diopsidis* Thaxter), *Cercyon* (*Entomocosma laboulbenioides* Speg.) and termites (*Coreomycetopsis oedipus* Thaxter and *Laboulbeniopsis termitarius* Thaxter). The described species occur in North and South America, in Western Africa (*Endosporella diopsidis*) and on Java (*Thaxteriola nigromarginata*). Two of these species, *Laboulbeniopsis termitarius* and *Coreomycetopsis oedipus* have recently been described in detail (Kimbrough, Gouger 1970; Blackwell, Kimbrough 1976, 1976a). The authors are convinced that the first fungus belongs to *Ascomycetes*, but its position within that class is still not clear.

The Polish specimens of fungi resemble the genus *Thaxteriola* by a small number of cells composing their thallus (in the genera *Endosporella* and *Laboulbeniopsis* the thallus is composed of 4 cells, in *Coreomycetopsis* there are more, up to 15). The simple structure of the upper cell of the thallus (sporogonium) is different than in the genus *Entomocosma*. A detailed analysis of the sporulation of the examined specimens was not possible as they had previously together with the hosts had been bleached with lactophenol for several days at about 50°C, and subsequently they were fixed as permanent microscope preparations by enclosing them in Faure's or Berlese's fluid or polyvinyl lactophenol. As a result of this treatment the content of the cells was in general not present and thus the use of staining methods like those used by Kimbrough and Gouger (1970) was useless. However in several specimens with broken off tops (Fig. 1 m, 2 b, 3 d) within the terminal cells the presence of cytoplasm granules was observed. They may be spores formed within the sporogonium, however it cannot be excluded that these were the remains of vacuolized cytoplasm, analogous to that found in old sporogonia of *Laboulbeniopsis termitarius* (Kimbrough, Gouger 1970).

The first of the examined fungi may be included in the genus *Thaxteriola* as a new species.

**Thaxteriola moseri** sp.n.

*Thallus fusiformis ex tribus cellulis una supra aliam positis constructus est. Longitudo cellulae basalis saepe minor quam dimidium longitudinis thalli. Unguis cum poro penetrabili. Parietis cellularis paene hyalinus excepta parte maiore cellulae basalis, ubi clare brunneus verruculosusque est. Longitudo 41-54  $\mu\text{m}$ , latitudo 4,5-6  $\mu\text{m}$ .*

Thallus spindle-shaped, consisting of three superposed cells. The basal cell usually not so long as a half of the thallus, slightly broader in the distal part and about the foot, further down sharply pointed. The foot lateral, brown, with dark margins and a paler central and front part with a penetration pore. The two upper cells tapering distally in the sharp spine which irregularly breaks off after the maturation. The distal cell longer than the second, the transverse septum between the second and third cell often disappearing in the mature specimens. The cell wall almost hyaline with the exception of the major part of the basal cell of the mature specimens which is pale brownish and fine-warted. Total length 41-54  $\mu\text{m}$ , greatest width 4,5-6  $\mu\text{m}$  (Fig. 1).

Holotype: on female of *Dendrolaelaps hexaspinosus* Hirsch. in galleries of *Hylurgus ligniperda* (Fabr.) on *Pinus sylvestris* L., Experimental Forest Zielonka near Poznań (Forestry Potasze), 17.XI.1974 leg. C. Pawlik. Paratypes: the same locality, on male and female of *Proctolaelaps fišeri* Samš. in gallery of *Hylurgops palliatus* (Gyll.) on *Pinus sylvestris*, 11.VIII.1974 leg. C. Pawlik; on female of *Proctolaelaps fišeri* Samš. in gallery of *Hylurgus ligniperda* (Fabr.) on *Pinus sylvestris*, 21.IX.1974 leg. C. Pawlik; on female of *Trichouropoda obscura* (C. L. Koch) and *Dendrolaelaps forcipiformis* Hirsch. in galleries of *Myelophilus piniperda* (L.) on *Pinus sylvestris*, 1.VI.1974 leg. C. Pawlik; on deutonymph of *Dendrolaelaps* sp. and female of *D. forcipiformis* Hirsch. in galleries of *Myelophilus piniperda* (L.) on *Pinus sylvestris*, 13.V.1974 leg. C. Pawlik; on female of *Dendrolaelaps armatus* Hirsch. in gallery of *Hylurgops palliatus* (Gyll.) on *Pinus sylvestris*, 2.II.1975 leg. C. Pawlik; on female of *Dendrolaelaps* sp. in gallery of *Hylurgus lingiperda* (Fabr.) on *Pinus sylvestris*, 9.III.1975 leg. C. Pawlik. Forestry Division Międzyzlesie in Sudety Mts. (Forestry Biała Woda), on deutonymph of *Trichouropoda dalarnaensis* (Sell.) in gallery of *Pityogenes chalcographus* (L.) on *Picea abies* Karst., 12.IV.1974 leg. N. Kędziora. Forests of Hel Peninsula, on protonymph of *Uroobovella ipidis* (Vitzth.) in undetermined bark beetle gallery, 23.X.1974 leg. Z. Sojeczki.

This species is dedicated to Dr. John Moser of South Forest Experimental Station, Pineville, Louisiana, who has been working on the acarofauna of bark beetles for many years.

The hitherto described species from the genus *Thaxteriola* differ from *Thaxteriola moseri* sp.n. by the following characters: *T. infuscata* — differs by a darker thallus, a distinctly though not strongly bent apex of the sporogonium, a foot placed at the base of the lower cell and not at its side (see Thaxter 1914 fig. 31, and Spegazzini 1918, p. 312 fig. 5), slightly

smaller size ( $40-45 \times 4-5 \mu\text{m}$ ); *T. subhyalina* — by a strongly bent apex of the sporogonium, considerably smaller dimensions ( $20 \times 3 \mu\text{m}$ ) and, if the drawing of Sp e g a z z i n i (1918, p. 312 fig. 6) is correct, a foot located at the base of the basal cell; *T. nigromarginata* — by a blackened wall of the upper cell, a foot at the base of the basal cell (T h a x t e r 1920, figs. 37-38) and larger size ( $62-68 \times 8-8.5 \mu\text{m}$ ).

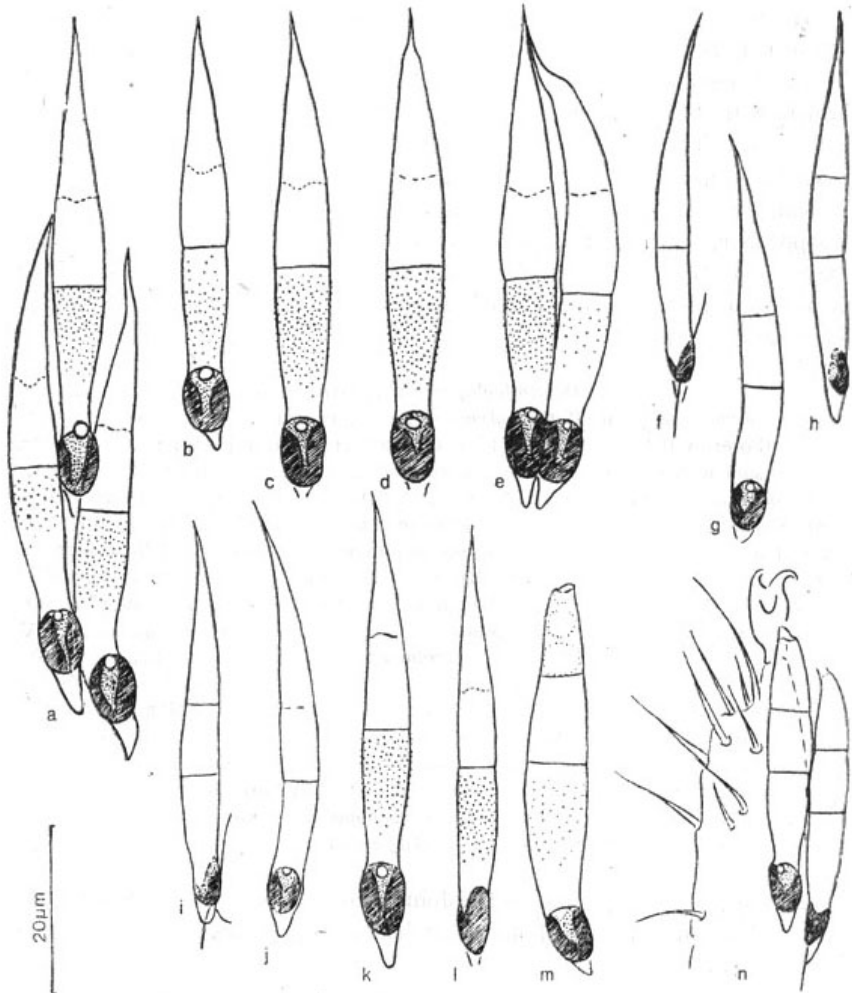


Fig. 1. *Thaxteriola moseri* sp.n.: a, b, c (holotype), d, e — on the dorsal plate (a) and on the legs of *Dendrolaelaps hexaspinosus* (Potasze); f-j — on legs of *Uroobovella ipidis* (Hel); k — on the dorsal plate of *Dendrolaelaps armatus* (Potasze); l, m — on a leg and on the pedipalp of *Dendrolaelaps* sp. (Potasze); n — on a leg of *Trichouropoda dalarnaensis* (Biała Woda)

The remaining two fungi have many characters in common. They are composed of only two cells, which makes them different from the representatives of all the above-mentioned genera. A second different character is the location in two different places of the basal cell: of a foot (with which the basal cell of the thallus is attached to the host) and of a penetration pore (by which the fungus may be assumed to take up nutrients from the host). Thus the fungus must tightly adhere to the host's surface at least with the basal cell (Figs. 2 j, 3 h). A similar situation has not been observed in any of the fungi known to as external parasites of arthropods described for example in the publications of Thaxter and Spegazzini cited above, or in the biologically similar group *Laboulbeniales*. Of course the possibility that a separated penetration pore exist in some of the described species but has been not noticed must be taken into consideration. This aspect of the morphology of external parasites of arthropods should be given close attention. However, at present the two above-mentioned characters differentiating the described fungi warrant including them in a new genus.

#### *Acariniola* gen.n.

*Thallus ex duabus cellulis una supra aliam positus constructus est. Unguis lateraliter atque paene apud basim cellulae basalis formatus est, attamen porus penetrabilis in parte posteriore eiusdem cellulae invenitur. Sporae intra cellulam subbasalem oriuntur, unde per foramen apicale ad extra exeunt.*

Axis simple, consisting of two superposed cells. Basal cell attached to the surface of the host by a lateral dark foot in the lower part of the cell and by a penetration pore in the distal part of the basal cell. The spores form within the upper cell (sporogonium) and pass out through a terminal pore.

Type species: *Acariniola subbasalipunctata* sp.n.

#### *Acariniola subbasalipunctata* sp.n.

*Thallus fusiformis. Cellula basalis paulo longior quam cellula subbasalis. Porus penetrabilis in longitudine circa 2/3 cellulae basalis invenitur. Parietes cellularis paene hyalinus, excepta media parte cellulae subbasalis, ubi clare brunneus et verruculosus est. Longitudo 24-53  $\mu$ m, latitudo 3-7  $\mu$ m.*

Thallus spindle-shaped. The basal cell somewhat longer than the upper one, broader in the distal half and about the foot, further down sharply pointed. The foot uniformly brown, oval, in lateral view almost semicircular. The penetration pore in about 2/3 of the length of the basal cell, sur-

rounded by a small brown circle. The upper cell (sporogonium) tapering distally in the sharp spine, which irregularly breaks off after the maturation. The cell wall almost hyaline with the exception of the middle part of the upper cell of the mature specimens which is pale brownish and fine-warted. Total length 24-53  $\mu\text{m}$ , greatest width 3-7  $\mu\text{m}$  (Fig. 2).

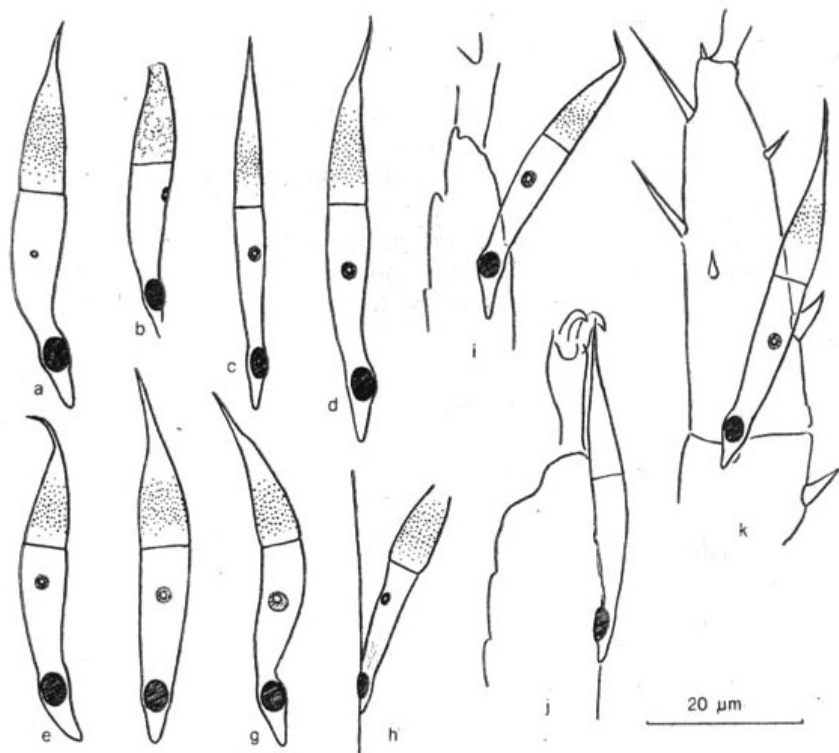


Fig. 2. *Acariniola subbasalipunctata* sp.n.: a (holotype), b—on a leg and on the dorsal plate of *Dendrolaelaps* sp. (Potasze); c-g — on a leg (c) and on the ventral plate of *Proctolaelaps fišeri* (Potasze); h-j—on legs of *Trichouropoda longiovalis* (Dębno); k—on a leg of *Trichouropoda dalarnaensis* (Biała Woda)

Holotype: on deutonymph of *Dendrolaelaps* sp. in. undetermined gallery of bark beetle on *Pinus sylvestris*, Experimental Forest Zielonka near Poznań (Forestry Potasze), 13.V.1974, leg. C. Pawlik. Paratypes: the same locality, on female of *Proctolaelaps fišeri* Samš. in gallery of *Meylophilus piniperda* (L.) on *Pinus sylvestris*, 5.V.1974 leg. C. Pawlik; on female of *Proctolaelaps fišeri* Samš. in galleries of *Hylastes ater* (Payk.) on *Pinus sylvestris*, 21.IV.1974 leg. C. Pawlik; on females of *Dendrolaelaps* sp. in galleries of *Pityogenes bidentatus* (Hrbst.) on *Pinus sylvestris*, 14.VI.1975 leg. C. Pawlik; on females of *Proctolaelaps fišeri* Samš. in galleries of *Hylurgops palliatus* (Gyll.) on *Pinus sylvestris*, 21.IX.1974 leg. C. Pawlik; on female

of *Dendrolaelaps hexaspinosus* Hirsch. in gallery of *Hylurgops palliatus* (Gyll.) on *Pinus sylvestris*, 17.XI.1974 leg. C. Pawlik; on female of *Dendrolaelaps* sp. in gallery of *Hylurgops palliatus* (Gyll.) on *Pinus sylvestris*, 2.III.1975 and 26.IV.1975 leg. C. Pawlik; on female of *Dendrolaelaps armatus* Hirsch. in gallery of *Hylurgops palliatus* (Gyll.) on *Pinus sylvestris*, 2.II.1975 leg. C. Pawlik; on females of *Dendrolaelaps septentrionalis* (Sell.) in galleries of *Myelophilus minor* (Hrtg.) on *Pinus sylvestris*, 5.V.1974 leg. C. Pawlik; on female of *Dendrolaelaps forcipiformis* Hirsch. in gallery of *Myelophilus piniperda* (L.) on *Pinus sylvestris*, 13.V.1974 leg. C. Pawlik; on deutonymph of *Dendrolaelaps* sp. in gallery of *Hylastes ater* (Payk.) on *Pinus sylvestris*, 21.IV.1974 leg. C. Pawlik; on protonymph of *Dendrolaelaps* sp. in gallery of *Hylastes* sp. on *Pinus sylvestris*, 26.IV.1975 leg. C. Pawlik; on deutonymph of *Dendrolaelaps* sp. in galleries of *Myelophilus piniperda* (L.) on *Pinus sylvestris*, 6.IV.1974 and 13.V.1974 leg. C. Pawlik. Świętokrzyski National Park (Forestry Dębno), on male and female of *Trichouropoda longiovalis* Hirsch. et Zirng.-Nic., on deutonymphs of *Dendrolaelaps* sp. and on larvae of *Uropodina* in galleries of *Pityokteines voronzowi* (Jacobs.) on *Abies alba* Mill., 7.XI.1974 leg. R. Kapuściński. Świętokrzyski National Park (Forestry Chełmowa Góra), on female of *Proctolaelaps fišeri* Samš. in gallery of *Myelophilus piniperda* (L.) on *Pinus sylvestris*, 26.XI.1974 leg. R. Kapuściński. Forestry Division Międzyzlesie in Sudety Mts. (Forestry Biała Woda), on deutonymph of *Trichouropoda dalarnaensis* (Sell.) in gallery of *Pityogenes chalcographus* (L.) on *Picea abies* Karst., 12.IV.1974 leg. N. Kędziora. Forestry Division Czersk in Tuchola Forest (Forestry Lipowo), on female of *Proctolaelaps rotundus* Hirsch. in undetermined gallery of bark beetle on *Pinus sylvestris*, VIII.1974 leg. L. Landowski. Forests of Hel Peninsula, on adult of *Pygmephorus* sp. in undetermined gallery on *Pinus sylvestris*, 16.XI.1974 leg. Z. Sojecki; on female of *Proctolaelaps fišeri* Samš. in undetermined galleries on *Pinus sylvestris*, 23.X.1974 and 10.XI.1974 leg. Z. Sojecki; on female of *Dendrolaelaps apophyseosimilis* Hirsch. in undetermined gallery on *Pinus sylvestris*, 25.IX.1974 leg. Z. Sojecki; on protonymph of *Dendrolaelaps* sp. in undetermined gallery on *Pinus sylvestris*, 23.X.1974 leg. Z. Sojecki; on female of *Dendrolaelaps* sp. in gallery of *Hylurgops palliatus* (Gyll.) on *Pinus sylvestris*, 22.X.1974 leg. Z. Sojecki; on male and female of *Dendrolaelaps* sp. in undetermined gallery on *Pinus sylvestris*, 17.XI.1974 leg. Z. Sojecki; on female of *Dendrolaelaps* sp. in gallery of *Myelophilus piniperda* (L.) on *Pinus sylvestris*, 17.XI.1974 leg. Z. Sojecki; on female of *Dendrolaelaps aisetosimilis* Hirsch. in undetermined gallery on *Pinus sylvestris*, 16.XI.1974 leg. Z. Sojecki; on male of *Dendrolaelaps* sp. in undetermined gallery on *Pinus sylvestris*, 30.XI.1974 leg. Z. Sojecki.

#### *Acariniola basalipunctata* sp.n.

*Similis A. subbasalipunctatae. Paries cellularis cellulae subbasalis paene hyalinus vel clare brunneus, tamen cellulae basalis clare brunneus et verruculosus est. Longitudo 34-51  $\mu$ m, latitudo 4,5-8  $\mu$ m.*

Similar to the previous described *Acariniola subbasalipunctata*, but somewhat stouter; the cell wall of the upper cell almost hyaline or pale brownish, the wall of the basal cell of the mature specimens pale brownish and fine-warted, the distal spine and the vicinity of the foot hyaline. Total length 34-51  $\mu$ m, g reatest width 4.5-8  $\mu$ m (Fig. 3).



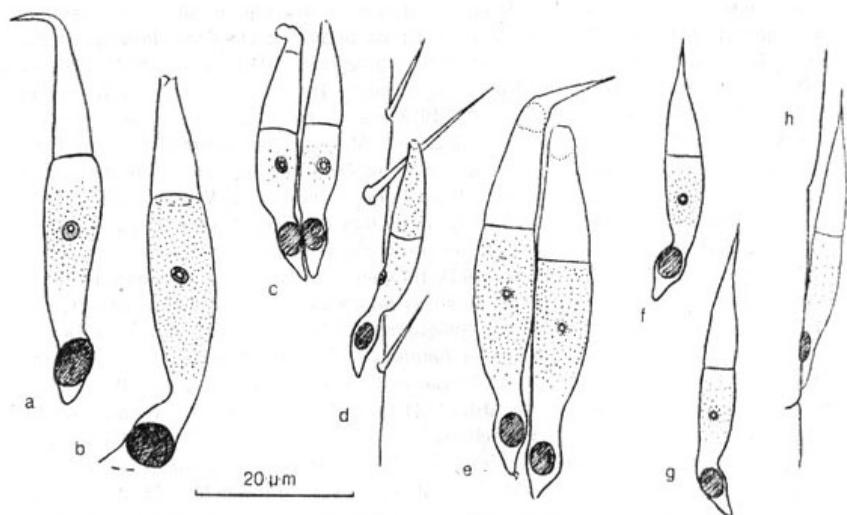


Fig. 3. *Acariniola basalipunctata* sp.n.: a (holotype), b — on legs of *Proctolaelaps* sp. (Potasze); c, d — on the dorsal plate and on a leg of *Dendrolaelaps armatus* (Potasze); e — on the dorsal plate of *Dendrolaelaps* sp. (Potasze); f, g — on the dorsal plate of *D. disetosimilis* (Dąbrowa); h — on *Proctolaelaps fischeri* (Dąbrowa)

Holotype: on female of *Proctolaelaps* sp. in galleries of *Hylastes ater* (Payk.) on *Pinus sylvestris*, Experimental Forest Zielonka near Poznań (Forestry Potasze), 1.V.1975, leg. C. Pawlik. Paratypes: the same locality, on male of *Dendrolaelaps armatus* Hirsch in gallery of *Myelophilus piniperda* (L.) on *Pinus sylvestris*, 3.III.1974 leg. C. Pawlik; on deutonymph of *Dendrolaelaps* sp. in gallery of *Myelophilus piniperda* (L.) on *Pinus sylvestris*, 13.IV.1974 leg. C. Pawlik; on female on *Dendrolaelaps septentrionalis* (Sell.) in undetermined gallery on *Pinus sylvestris*, 21.IX.1974 leg. C. Pawlik. Świętokrzyski National Park (Forestry Dąbrowa), on female of *Dendrolaelaps disetosimilis* Hirsch., on deutonymph of *Dendrolaelaps* sp. and on female of *Proctolaelaps fischeri* Samš. in galleries of *Myelophilus piniperda* (L.) on *Pinus sylvestris*, 7.XI.1974 leg. R. Kapaściński.

Fairly numerous juvenile specimens of fungi from the genus *Acariniola* cannot be included in one of the two described species due to the lack of characteristic differences in pigmentation of the upper or lower cell of the thallus. They were collected in the following localities:

Woliński National Park, on female of *Dendrolaelaps tenuipilus* Hirsch. and deutonymphs of *Dendrolaelaps cornutus* (Kram.) in galleries of *Scolytus intricatus* Ratz. on *Quercus* sp., 10.X.1973 leg. B. Jakuczun; on deutonymphs of *Dendrolaelaps cornutus* (Kram.) and *Dendrolaelaps* sp. in galleries of *Myelophilus piniperda* (L.) on *Pinus sylvestris*, 10.X.1973 leg. B. Jakuczun. Experimental Forest Zielonka near Poznań (Forestry Potasze), on deutonymph of *Dendrolaelaps* sp. in gallery of *Myelophilus piniperda* (L.) on *Pinus sylvestris*, 6.IV.1974 leg. C. Pawlik; on female



of *Proctolaelaps rotundus* Hirsch. in gallery of *Polygraphus polygraphus* (L.) on *Pinus sylvestris*, 25.V.1974 leg. C. Pawlik. Świętokrzyski National Park (Forestry Chel-mowa Góra), on female of *Dendrolaelaps tenuipilus* Hirsch. in gallery of *Myelophilus piniperda* (L.), 26.XI.1974 leg. R. Kapuściński

On the basis of the material elaborated and described above it is difficult to draw conclusions as to the possible relationships and place in the taxonomy of fungi of the new taxons. The available specimens did not allow observations on the life cycle of the new species to be made, and even their method of sporulation is hitherto uncertain. Therefore it seems that it will be better to abstain from making guesses even as to the relationship of these fungi to *Ascomycetes*.

The holotypes of the new species can be found in the herbarium of the Mycological Laboratory of the Institute of Botany of the Polish Academy of Sciences in Warsaw, the paratypes partly in the same collection and partly in the collection of the Institute of Forest Protection, Academy of Agriculture in Poznań.

#### Acknowledgements

We would like to express our gratitude to the Department of Agriculture of the United States for funding these investigations within the subject FG-Po-292 (PL-FS-65) and to the sponsor, Dr. John C. Moser of Southern Forest Experimental Station, Pineville, Louisiana, for the help in performing investigations on the acarofauna of bark beetles. We would like to thank Dr. K. Nowak for preparing the Latin diagnoses.

#### REFERENCES

- Bałazy S., Kiełczewski B., Wiśniewski J., 1977, Zarodniki grzybów przynoszone przez roztocze występujące w żerowiskach korników, Pozn. Tow. Przyj. Nauk, Prace Kom. Nauk Roln. i Kom. Nauk Leśn.
- Blackwell M., Kimbrough J. W., 1976, Ultrastructure of the termite-associated fungus *Laboulbeniopsis termitarius*, Mycologia 68: 541-550.
- Blackwell M., Kimbrough J. W., 1976a, A developmental study of the termite-associated fungus *Coreomyces oedipus*, Mycologia 68: 551-558.
- Kimbrough J. W., Gouger R. J., 1970, Structure and development of the fungus *Laboulbeniopsis termitarius*, Journ. Invertebr. Path. 16: 205-213.
- Spegazzini C., 1918, Observaciones microbiológicas, Anales Soc. Cient. Argentina 85: 311-323.
- Thaxter R., 1914, On certain peculiar fungus-parasites of living insectes, Botan. Gazette 58: 235-253, pl. 16-19.
- Thaxter R., 1920, Second note on certain peculiar fungus-parasites of living insects, Botan. Gazette 69: 1-27, pl. 1-5.

## Nowe gatunki grzybów pasożytujących na roztoczach (Acarina)

### Streszczenie

Autorzy opisują trzy nowe grzyby, pasożyty zewnętrzne roztoczy występujących w żerowiskach korników: *Thaxteriola moseri*, *Acariniola subbasalipunctata* i *A. basalipunctata*. Dwa ostatnie zaliczono do nowego rodzaju *Acariniola*, różniącego się od innych przedstawicieli grupy *Thaxteriolae* mniejszą liczbą komórek składających się na plechę (tylko dwie) oraz porą penetracyjną oddzielony od stopy.