jours). Douze spécimens ont été obtenus d'élevages réalisés à partir de la ponte. Ceci a permis de calculer les durées moyennes des différents stades. Entre la ponte et l'éclosion de l'oeuf il y a 7,5 jours. La durée du stade chenille est de 46 jours et celle du stade chrysalide 17 jours. La durée moyenne totale du développement larvaire est donc de 70 jours.

Conclusion

Cette première publication, sur ces trois familles, apporte de nombreux renseignements sur les plantes consommées par les chenilles de la plupart des espèces citées et quelques données sur la durée des développements larvaires. Mais, la liste des espèces présentes à Lamto est très incomplète et pourra sans doute être augmentée considérablement lors d'une publication ultérieure.

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Laboulbeniales (Ascomycetes) of Belgian Staphylinidae (Coleoptera)

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Summary

Laboulbeniales on Belgian Staphylinidae are treated for the first time. Distributional, floristic and biological notes are presented on 17 taxa. The following species are reported for the first time in Belgium: Cantharomyces orientalis SPEGAZZINI, Cantharomyces thaxteri MAIRE, Cantharomyces venetus SPEGAZZINI, Compsomyces lestevae THAXTER, Corethromyces stilici THAXTER, Laboulbenia stilicicola SPEGAZZINI, Monoicomyces britannicus THAXTER, Monoicomyces californicus (THAXTER) THAXTER, Monoicomyces fragilis SCHELOSKE, Monoicomyces invisibilis THAXTER. *9 taxa are illustrated. A parasite-host list of all Laboulbeniales reported on Belgian Staphylinidae is given.*

Résumé

Cet article est la première contribution à la connaissance des Laboulbéniales des Staphylinidae de Belgique. Des notes sont fournies à propos de la distribution, la floristique et la biologie de 17 espèces. Dix sont nouvelles pour la mycoflore Belge. Cantharomyces orientalis SPEGAZZINI, Cantharomyces thaxteri MAIRE, Cantharomyces venetus SPEGAZZINI, Compsomyces lestevae THAXTER, Corethromyces stilici THAXTER, Laboulbenia stilicicola SPEGAZZINI, Monoicomyces britannicus THAXTER, Monoicomyces californicus (THAXTER) THAXTER, Monoicomyces fragilis SCHELOSKE, Monoicomyces invisibilis THAXTER. *9 espèces sont illustrées. Une liste complète des Laboulbeniales observées sur les Staphylinidae de Belgique est présentée.*

Introduction

Laboulbeniales are obligate ectoparasites of Arthropoda. They belong to the Ascomycetes, about 2000 species are known. The thalli of Laboulbeniales are small and almost restricted to reproductive structures. Typical fungi-like features such as mycelial growth or hyphae are absent. The thalli of Laboulbeniales consist of a receptacle, which is firmly attached to the host. The female reproductive structure or perithecium, antheridia and sterile appendages are born on the receptacle. The receptacle consists of a restricted number of cells, it is characterized by a great cellconstancy.

Laboulbeniales have a narrow host-range and usually they are specialized in a closely related group of hosts. The majority of Laboulbeniales are parasites of true insects (Hexapoda), but also mites (Arachnida) and millipedes (Diplopoda) have been reported as hosts. Most of the Laboulbeniales of Hexapoda infest Coleoptera, but also Blattaria, Dermaptera, Diptera, Hemiptera, Hymenoptera, Isoptera, Mallophaga, Orthoptera and Thysanoptera can be infected. Laboulbeniales usually penetrate the outer layers of the integument of the host and appear to behave as real parasites. BRO LARSEN (1952) attributed the considerable mortality rate of a Staphylinid population *(Bledius)* to the effect of Laboulbeniales. Till now it has not been proved significantly that Laboulbeniales are harmful to their host, a general fitness deterioration can be suspected.

The infection with Laboulbeniales takes place from spores in the soil (LINDROTH, 1948) and contact with other insects (SCHELOSKE, 1969). Specific behaviour such as copulation and grooming modify the infection and its pattern significantly (DE KESEL, unpublished data).

Most of the questions related to the nutrition, ecology, phylogeny and pathology of Laboulbeniales remain unanswered. The ecology of the parasite and its effect on the host, the ability to infect potential hosts and the intraspecific variability in relation to the host have hardly been studied. The answer to these questions could help us find clues to the phylogeny of parasite and host.

A comprehensive account on Laboulbeniales is given by BENJAMIN (1971).

Recently a check-list of the Belgian Laboulbeniales was published (DE KESEL & RAMMELOO, 1991). The aim of this paper is to supplement our knowledge on the account of the Laboulbeniales, but also to supply mycologists and entomologists with information on parasite-host associations.

Material

The infected specimens in the present study were mainly obtained from the Staphylinid collection of G. HAGHEBAERT (Koninklijk Belgisch Instituut voor Natuurwetenschappen, Vautierstraat 29, B-1040 Brussels, Belgium). A minor part was obtained from the collection of A. DE KESEL.

The specimens of the HAGHEBAERT collection were gathered by members of the Entomology department of the K.B.I.N. The localities and corresponding collecting methods are listed.

- Erpent (U.T.M.: FR 39) Malaise trap, leg. C. FASSOTTE;
- Beernem (U.T.M.: ES 26) pitfall trap, leg. M. POLLET;
- Raversijde (U.T.M.: DS 87) Malaise and pifall trap, leg. G. HAGHEBAERT;
- Werbomont (U.T.M.: FR 88) Malaise trap, leg. R. DETRY;
- Ottignies (U.T.M.: FS 11) Malaise trap, leg. P. DESSART;
- Oostende (U.T.M.: DS 97) handcaptures, leg. G. HAGHEBAERT;
- Lombardsijde (U.T.M.: DS 86) coloured waterdishes, leg. G. HAGHEBAERT & P. GROOTAERT;
- Koksijde (U.T.M.: DS 76) Malaise trap, leg. A. MUYLAERT;
- Logne (U.T.M.: FR 88) Malaise trap, leg. R. DETRY;
- Zandvliet (U.T.M.: ES89) handcaptures, leg. G. HAGHEBAERT;

- Neigem (U.T.M.: ES 72) pitfall trap, leg. L. VAN HERCKE;
- Moha (U.T.M.: FS 50) pitfall trap, leg. R. DETRY & L. BAERT;
- Bornem (U.T.M.: ES 86) pitfall trap, leg. A. DE KESEL;

The fungus material and the infested insects are stored in separate collections, both are deposited in the herbarium BR (Nationale Plantentuin van België, Domein van Bouchout, B-1860 Meise). The abbreviation ADK refers to the slide collection of Laboulbeniales of A. DE KESEL (BR).

Method

The fungi have been mounted as described in DE KESEL (1989) and BENJAMIN (1971). All drawings are made using a drawing tube. The parasites are listed in alphabetical order, following the nomenclature proposed by TAVARES (1985). The nomenclature of Staphylinidae follows KLOET & HINCKS (1977). The data collected on the infested insects are locality (UTM), date, habitat and infectionpattern. Measurements and description of the thallus, main Staphylinid hosts and distribution in Europe is presented for each parasite.

Results

Review of the species

Cantharomyces orientalis SPEGAZZINI (Figure 1a).

C. orientalis is new for the Belgian mycoflora.

* General habitus : The receptacle consists of two superposed cells. The subbasal cell bears perithecia, antheridia and a short primary appendage. The compound antheridium is situated in the second appendage cell (HULDÉN, 1985). The variation in form and dimensions of *Cantharomyces orientalis* is due to the position of the thalli on the host (SCHELOSKE, 1969). We did not find extreme differences in thallus development as indicated by SCHELOSKE (1969).
* Size of the thalli : 120-170μm, perithecium 70-95μm X 25-35μm, stalk of the perithecium 20-50μm, receptacle 20-30μm, primary appendage 30-50μm, spores 25μm X 3-5μm.
* Material examined :

Carpelimus corticinus (GRAVENHORST, 1806): (B) Zandvliet, Groot Buitenschoor, on clayey sand in the intertidal zone, 11.IV.1990, slide ADK317

Carpelimus foveolatus (SAHLBERG, 1832): (B) Oostende, polder, 31.V.1991, slide ADK404.

* Infection : on elytra, cephalon and abdominal terga.
* Distribution in Europe : Belgium; Federal Republic of Germany (SCHELOSKE, 1969); Finland (HULDÉN, 1983); Italy (SPEGAZZINI, 1915c); Netherlands (MIDDELHOEK, 1949); Poland (SIEMASZKO & SIEMASZKO, 1932); Sweden (HULDÉN, 1985); Switzerland (HULDÉN, 1985).
* Staphylinid hosts : *Rugilus* (FRANK, 1982), *Carpelimus*
* Ethology of the host : *Carpelimus corticinus* is a eurytopic species, one of the most common *Carpelimus* species in Belgium. *Carpelimus foveolatus* is a rare halotolerant species only known from ten Belgian localities.

Cantharomyces thaxteri MAIRE (Figure 1b).

The fungus is new for the Belgian mycoflora, it was found on *Carpelimus bilineatus* (STEPHENS, 1834) and *Carpelimus rivularis* (MOTSCHULSKY, 1860).
* General habitus : The receptacle consists of a basal and subbasal cell. The subbasal cell is usually black or dark-brown on both sides. A single appendage arises from the subbasal cell. The subbasal cell of the appendage is squarrish in optical section and bears a strongly inflated compound antheridium with one or two sterile appendages. The perithecium is symmetrical and relatively long stalked. The apical side of the perithecium is conical and the basal side is strongly inflated. We observed only one perithecium per thallus. The thalli on *Carpelimus rivularis* are slightly taller (210-250μm).
* Size of the thalli : total length 160-200μm, perithecium with basal cells 80-110μm X 45-50μm, stalk of the perithecium 50-65μm, receptacle 35-40μm, antheridia 25-30μm X 25-30μm, appendages 70-75μm.
* Material examined :
Carpelimus bilineatus (STEPHENS, 1834): (B) Oostende, garden, 5.VII.1991, slide ADK416.
Carpelimus rivularis (MOTSCHULSKY, 1860): (B) Oostende, polder, 28.VI.1991, slide ADK410.
* Infection : thalli were found on elytra, meso-, metasternum and legs.
* Distribution in Europe : Belgium; France (PICARD, 1917; BALAZUC, 1974); Hungary (BANHEGYI, 1944); Poland (SIEMASZKO & SIEMASZKO, 1932).
* Staphylinid hosts : *Carpelimus* and *Thinodromus* (FRANK, 1982). STADELMANN & POELT (1962) mentioned *Cantharomyces thaxteri* on *Catops nigricans* SPENCE (Coleoptera, Catopidae). STADELMANN & POELT (1962) presumably misinterpreted MIDDELHOEK (1943c) who found *Asaphomyces tubanticus* (MIDDELHOEK & BOELENS) SCHELOSKE on *Catops nigricans*.

Cantharomyces venetus SPEGAZZINI (Figure 1c).

The fungus is new for the Belgian mycoflora, it was found on *Carpelimus rivularis* (MOTSCHULSKY, 1860).
* General habitus : The thalli found on the mesothorax are very large, they fit the description given by THAXTER (1931). The receptacle consists of a basal and subbasal cell. The latter bears stalked perithecia and a single appendage. The perithecium is subsymmetrical and long-stalked, up to 3 perithecia were found per thallus. The appendage is rather robust and consists of 4 to 6 cells. Its subbasal cell is fertile and produces the spermatia on the inner side. The sterile cells of the appendage are born on the subbasal cell and bear several short and stiff branches. On the elytra of the same specimen we found smaller thalli which we identified as *Cantharomyces thaxteri* MAIRE. They lack the typical branches and their perithecial stalk cells are shorter.
* Size of the thalli : total length of the thalli 320-350μm, perithecium and basal cells 120-150μm X 50-70μm, perithecial stalk cell 90-175μm, receptacle 50-70μm, appendage 75-100μm, antheridium 35-50μm X 30-40μm, branches 20-100μm.
* Material examined :
Carpelimus rivularis (MOTSCHULSKY, 1860): (B) Oostende, polder (b.H), 28.VI.1991, slide ADK410.

* Infection : infections occur on legs and mesothorax. *Cantharomyces thaxteri* was found on the elytral margins.
* Distribution in Europe : Poland (SIEMASZKO & SIEMASZKO, 1932); Italy (SPEGAZZINI, 1915); Belgium.
* Staphylinid hosts : *Carpelimus* (FRANK, 1982)

Compsomyces lestevae THAXTER

The fungus is new for the Belgian mycoflora, it was found on *Lestava heeri* FAUVEL, 1872.
* General habitus : The receptacle consists of a basal and subbasal cell, the latter giving rise to at least 3 branches. The perithecium stalk cell is born on the basal cell of one of these branches, which is unique in this genus (TAVARES, 1985; THAXTER, 1908). The perithecium is symmetrical and has an undifferentiated tip. Furcate secondary axes with intercalary antheridia are born on the subbasal cell of the receptacle. The antheridia are not very numerous but easily recognised by their short lateral necks through which the spermatia are discharged.
* Size of the thalli : total length 280-320μm, perithecium with basal cells 100-125μm X 40-60μm, antheridial branches 200-300μm, receptacle 50-60μm, spores 40μm X 3μm.
* Material examined:
Lesteva heeri FAUVEL, 1872: (B) Moha, forest, 13.XII.1979, slide ADK396
* Infection : Abdominal segments, legs, meta- and mesothorax.
* Distribution in Europe : Belgium; Poland, France (BALAZUC, 1973 and 1974); Spain (SANTAMARÍA & GIRBAL, 1987); Britain (THAXTER, 1908); Italy (ROSSI & ROSSI, 1978).
* Staphylinid hosts : *Lesteva* (FRANK, 1982).

Corethromyces stilici THAXTER

The fungus is new for the Belgian mycoflora, it was found on *Rugilus rufipes* GERMAR, 1836.
* General habitus : The receptacle consists of a basal and subbasal cell. The perithecium is irregular in outline which is caused by the spiral twist of the outer wall cells. The apex is blunt and relatively broad. The short perithecial stalk cell is born on the subbasal cell of the receptacle. The basal cell of the receptacle is , in spite a small hyaline spot above the foot, entirely black. It bears a typical straight, black and finger-like outgrowth. The primary appendage is also born on the subbasal cell of the receptacle, it is hyaline and forms a few short branches.
The function of the black outgrowth is unknown. *Corethromyces stilici* is a small species and it is easily overlooked when appressed on the sclerites.
* Size of the thalli : total length 150-160μm, perithecium with basal cells 110μm X 30μm, receptacle 30-35μm, finger-like outgrowth 70μm X 8μm, appendages 60μm, perithecial stalk cell 25-30μm.

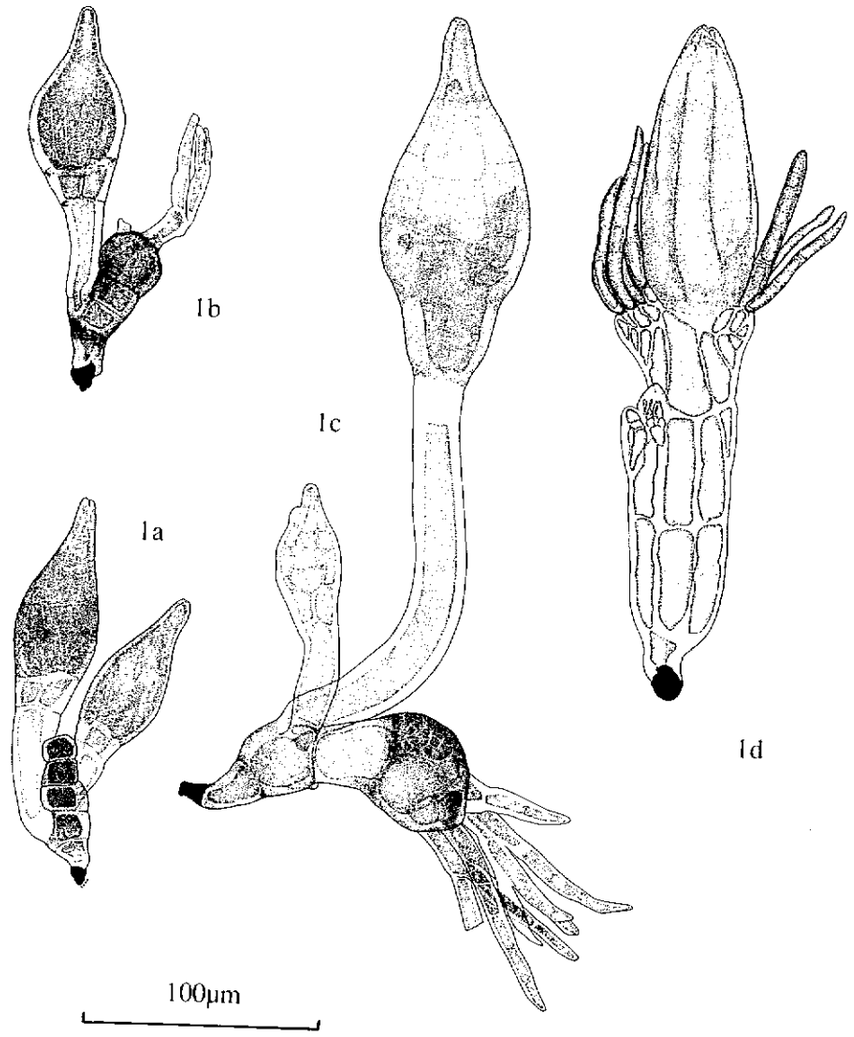

Fig 1. - 1a. Cantharomyces orientalis SPEGAZZINI from cephalon of Carpelimus corticinus (GRAVENHORST, 1806); 1b. Cantharomyces thaxteri MAIRE from legs of Carpelimus bilineatus (STEPHENS, 1834); 1c. Cantharomyces venetus SPEGAZZINI from mesothorax of Carpelimus rivularis (MOTSCHULSKY, 1860); 1d. Peyritschiella protea THAXTER from abdomen of Oxytelus rugosus (FABRICIUS, 1775). - scale = 100µm.

* Material examined :
Rugilus rufipes (GERMAR, 1836): (B) Neigem, forest, 18.V.1977, slide ADK417
Rugilus similis (ERICHSON, 1839): (B) Beernem, Bulskampveld, 12-26.VI.1986, slide ADK419
* Infection :Infections on legs and last abdominal segments.
* Distribution in Europe : Belgium; Switzerland (BAUMGARTNER, 1923); Netherlands (MIDDELHOEK, 1943a); Germany (SCHELOSKE, 1969), Italy (FRANK, 1982).
* Staphylinid hosts : confined to *Rugilus* (FRANK, 1982).

Euzodiomyces lathrobii THAXTER

The fungus was already reported in Belgium on *Lathrobium brunnipes* (FABRICIUS, 1792) and *Lathrobium multipunctatum* (GRAVENHORST, 1802) by COLLART (1945). We found *E. lathrobii* on *Lathrobium elongatum* (LINNAEUS, 1767).
* General habitus : the specimens fit the description given by THAXTER (1908). The parasite was recently illustrated in DE KESEL & RAMMELOO (1991, fig1c).
* Size of the thalli : total length from foot to perithecial apex 275-300µm, perithecia 60-80µm X 20-30µm.
* Material examined :
Lathrobium elongatum (LINNAEUS, 1767): (B) Bornem (Hingene), Schellandpolder, 12.VI.1991, slide ADK362
* Infection : thalli were found on the abdominal terga.
* Distribution in Europe : Yugoslavia (BANHEGYI, 1960); Netherlands (MIDDELHOEK, 1943a); Switzerland (BAUMGARTNER, 1923); Germany (SCHELOSKE, 1969); France (BALAZUC, 1973); Belgium (COLLART, 1945; DE KESEL & RAMMELOO, 1991); Finland (HULDÉN, 1983); Poland (MAJEWSKI, 1973); Britain (BISBY & MASON, 1940); Spain (SANTAMARIA & GIRBAL, 1987).
* Staphylinid hosts : *E. lathrobii* seems to be confined to the staphylinid genera *Lathrobium, Lobrathium* and *Homaeotarsus* (FRANK, 1982). SCHELOSKE (1969) also found it on *Patrobus atrorufus* STROEM. (Coleoptera, Carabidae).

Laboulbenia cristata THAXTER

Laboulbenia cristata was earlier reported by COLLART (1945) and DE KESEL & RAMMELOO (1991) on *Paederus riparius* LINNAEUS, 1758 and *Paederus littoralis* GRAVENHORST, 1802. We also found the fungus on *Paederus littoralis*.
* General habitus : Our specimens correspond with the original description given by THAXTER (1896). The variation in this species is very small, except in the number of appendages (THAXTER, 1908). The thallus has typical morphological characteristics which makes it easy to recognize within the genus *Laboulbenia*. The outwardly curved perithecium has two dark regions near the apex. The inner basal cell of the appendages bears two short basal cells with antheridia. The outer basal cell bears a short, black, sterile, outer appendage and two thick, sterile, inner appendages. In most of the adult specimens we found that damaged inner appendages show regenerative growth. The outermost black appendage is usually damaged in adult specimens and does not regenerate.
* Size of the thalli : total length from foot to perithecial apex 250-350µm, sterile appendages 200µm, perithecium 100-150µm X 60-75µm, spores 50-55µm X 4-

5μm.
* Material examined :
Paederus littoralis GRAVENHORST, 1758: (B) Neigem, forest, 18.V.1977, slide ADK420.
* Infection : thalli were found on the elytra, legs and abdominal terga.
* Distribution in Europe : Belgium; France (BALAZUC, 1973); Germany, Italy (STADELMAN & POELT, 1962); Austria (THAXTER, 1908); Switzerland (BAUMGARTNER, 1923); Poland (SIEMASZKO & SIEMASZKO, 1932); Netherlands (MIDDELHOEK, 1943a); Portugal, Spain, Hungary, Yugoslavia, Albania (SCHELOSKE, 1969).
* Staphylinid hosts : *L. cristata* is cosmopolitan and occurs only on *Paederus*, the latter has never been found infested with another Laboulbeniaceous parasite. STADELMANN & POELT (1962) mentioned *L. cristata* on *Badister sodalis* (DUFTSCHMIDT) (Coleoptera, Carabidae), their find is curious and should be checked.

Laboulbenia stilicicola SPEGAZZINI

L. stilicicola is new for the Belgian mycoflora.
* General habitus : *L. stilicicola* belongs to the *Laboulbenia vulgaris* - group. It is characterized by the small basal cell of the inner appendage and a wedge-shaped V cell. The insertion cell, situated between appendages and receptacle, is black. The outer appendage is usually simple and poorly branched, the inner appendage is very small. Our specimens have a nearly triangular cell I and a relatively long cylindrical cell II. Our specimens resemble *Laboulbenia subterranea* THAXTER.
* Size of the thalli : 200-250μm, perithecium 110-140μm, receptacle 90-110μm, all appendages of mature thalli are damaged.
* Material examined :
Rugilus orbiculatus (PAYKULL, 1789): (B) Koksijde, dunes, 22-29.VII.1984, slide ADK341(a,b,c).
* Infection : on the hidden side of the right elytron, on the abdominal sternites and on the right hind wing. We presume that the infection on the right hand wing is from spores coming from mature thalli on the hidden side of the right elytron. A typical example of direct infection (SCHELOSKE, 1969).
* Distribution in Europe : Belgium; France (BALAZUC, 1973-1974); Finland (HULDÉN, 1983); Italy (SPEGAZZINI, 1914); Netherlands (MIDDELHOEK, 1943a); Poland (SIEMASZKO & SIEMASZKO, 1932); Switzerland (BAUMGARTNER, 1923); United Kingdom (THAXTER, 1908).
* Staphylinid hosts : *Rugilus* (syn. *Stilicus)*
* Ethology of the host : detricolous species, common in Belgium.

Monoicomyces britannicus THAXTER (Figure 2a).

M. britannicus is new for the Belgian mycoflora, it was found on *Atheta (Thinobaena) vestita* (GRAVENHORST, 1806) and *Atheta (Mocyta) fungi* (GRAVENHORST, 1806).
* General habitus : The receptacle consists of two cells, the subbasal cell bears the primary appendage and one or more fertile branches. Each fertile branch consists of a single cell bearing a compound antheridium and a perithecium. The perithecium and its stalk cell from the thalli on *Atheta (Mocyta) fungi* are longer

than those on *Atheta (Thinobaena) vestita.* The terminal cells of the antheridium have typical finger-like outgrowths. The primary appendage is dark blackish-brown and its third cell is constricted at the base. The stalk cell of the perithecium is always bent. *M. britannicus* is closely related to *Monoicomyces homalotae* THAXTER (THAXTER, 1908)
* Size of the thalli on *Atheta (Thinobaena) vestita* : 110-175μm, perithecium 90-110μm X 40-55μm, stalk of the perithecium 20-50μm, receptacle 15-30μm, appendage 20-40μm, antheridia 60-70μm X 25-35μm.
* Size of the thalli on *Atheta (Mocyta) fungi* : 210-230μm, perithecium 120-140μm X 50-55μm, stalk of the perithecium 60-70μm, receptacle 40μm, appendage 30-40μm, antheridia 60-70μm X 20-25μm.
* Material examined :
Atheta (Thinobaena) vestita GRAVENHORST, 1806): (B) Nieuwpoort, Ijzermonding, saltmarsh, 14.V.1989, slide ADK319 (a,b).
Atheta (Mocyta) fungi (GRAVENHORST, 1806): (B) Lombardsijde, slipway (3), 21.VII. 1989, slide ADK353.
* Infection : The most important infections on *Atheta (Thinobaena) vestita* occur on the last abdominal segments and in the entire pleuron. We also found thalli on the prolegs and the elytra.
On *Atheta (Mocyta) fungi* the infections are restricted to the abdominal sternites.
* Distribution in Europe : Belgium; Britain (THAXTER, 1908; BISBY & MASON, 1940); Federal Republic of Germany (SCHELOSKE, 1969); Finland (HULDÉN, 1983); France (PICARD, 1917; BALAZUC, 1974); Italy (SPEGAZZINI, 1915c); Poland (SIEMASZKO & SIEMASZKO, 1932).
* Staphylinid hosts : On *Atheta* spp., *A. longicornis* (GRAVENHORST, 1802) (HULDÉN, 1983), *Atheta (Aloconota) insecta* THOMSON, 1856 (STADELMANN & POELT, 1962). *Atheta (Thinobaena) vestita* and *Atheta (Mocyta) fungi* are new hosts for *M. britannicus.*
* Ethology of the host : *A. vestita* is an exclusive halobiontic species, scarce in Belgium. *A. fungi* is an extremely common eurytopic species.

Monoicomyces californicus (THAXTER) THAXTER (Figure 2b).

The fungus is new for the Belgian mycoflora, it was found on *Anotylus sculpturatus* (GRAVENHORST, 1806).
* General habitus : The receptacle consists of a basal and subbasal cell. The latter produces terminally a dark brown sterile appendage and laterally one or two fertile branches. These lateral branches are not clearly distinguished from the receptacle. Thalli with two fertile branches resemble *Monoicomyces furcatus* THAXTER as they have a furcate habitus. The fertile branches consist of two obliquely superposed cells. The lower cell bears sterile hyaline appendages. The upper cell bears the stalk cell of the perithecium and an antheridium with terminal appendages. The perithecium is flask shaped and has two well distinguished basal cells. In some cases a single fertile appendage produces more than one perithecium.
There is a great variation in the thallus development of *M. californicus.* The dark brown sterile appendage is not always present. Especially small thalli with one fertile branch can easily be misinterpreted as *M. invisibilis* THAXTER. A few fully developed *M. californicus* had a total length of 140μm, perithecium with basal

cells 80μm X 25μm and antheridia of 30μm X 15μm.
* Size of the thalli : 210-325μm, perithecium with basal cells 120-175μm X 40-55μm, stalk of the perithecium 50-100μm, receptacle 20-30μm, sterile appendages 30-60μm, antheridia 40-80μm X 15-25μm.
* Material examined :
Anotylus sculpturatus (GRAVENHORST, 1806): (B) Raversijde, dune, V.1984, ADK343 (a,b,c); (B) Logne, 9-23.VI.1989, slide ADK394; (B) Neigem, woods, 18.V.1977 & 9.VI.1977, slides ADK397, ADK399.
* Infection : Infections occur on all sclerites. Especially abdominal sternites, legs (tarsi), episternum and lower parts of the cephalon are heavily infected.
* Distribution in Europe : Belgium; France (BALAZUC, 1974); Netherlands (MIDDELHOEK, 1943d).
* Staphylinid hosts : Confined to *Anotylus* and *Oxytelus* (FRANK, 1982)
* Ethology of the host : nests of moles (BALAZUC, 1974), coprophagous, detricolous, the most common *Anotylus* species from Belgium.

Monoicomyces fragilis SCHELOSKE

The fungus is new for the Belgian mycoflora, it was found on *Ocalea picata* (STEPHENS, 1832).
* General habitus : The receptacle consists of a poorly pigmented basal and subbasal cell. The receptacle bears a strongly pigmented primary appendage which is born on the subbasal cell. It is sterile and becomes more hyaline towards its terminal end. Two, sometimes four, secondary receptacles are formed on the basal and subbasal cell of the receptacle. They are strongly pigmented, especially on the outer side of their basal and subbasal cell. The basal cell of the secondary receptacles bears a perithecium and antheridial branch. The perithecium is suboval and tapers towards the ostiolum. The antheridia consist of three pairs of hyaline cells which are intercalary on the secondary receptacles. M. fragilis is the most pigmented species of the genus *Monoicomyces*.
* Size of the thalli : total length foot-perithecial apex 175-250μm, receptacle 30-40μm, secondary receptacles 150-350μm, perithecium with basal cells 80-100μm X 25-30μm, primary appendage 100-150μm.
* Material examined :
Ocalea picata (STEPHENS, 1832): (B) Moha, forest, 13.XII.1979, slides ADK395 (a,b)
* Infection : abdominal terga and sternites.
* Distribution in Europe : Belgium; Germany (SCHELOSKE, 1969).
* Host : *Ocalea picata* (STEPHENS, 1832)

Monoicomyces invisibilis THAXTER (Figure 2c).

The fungus is new for the Belgian mycoflora, it was found on *Platystethus (Pyctocraerus) arenarius* (FOURCROY, 1785).
* General habitus : Our material corresponds with the description given by THAXTER (1908). THAXTER states that *M. invisibilis* forms only one fertile branch on the subbasal cell of the receptacle. We found a few thalli with two fertile branches and thus strongly resembling *M. furcatus*. THAXTER (1931) already mentioned that *M. furcatus* and *M. invisibilis* are near allies. The dimensions of our specimens are clearly inferior to those of *M. furcatus*. We are placing our specimens under *M. invisibilis*.
According to HULDÉN (1983) *Platystethus* might be an accidental host of *M. invisibilis* because it is mostly found on *Oxytelus*. We believe that *P. arenarius* is a genuine host because it belongs to the Oxytelinae.
* Size of thalli : 130-170μm, perithecium 80-110μm X 30-40μm, stalk cell of the perithecium 20-40μm, receptacle 20-40μm, appendage 30-40μm, antheridia 20-30μm X 15μm, antheridial outgrowths 20-80μm.
* Material examined :
Platystethus arenarius (FOURCROY, 1785): (B) Lombardsijde-Brandaris, slipway 2, 16.IV.1989, ADK352 (a,b,c).
* Infection : The specimen was strongly infested on elytra, thorax and abdominal tergites. Some thalli were found on the prolegs.
* Distribution in Europe : Belgium; Finland (HULDÉN, 1983); Italy (SPEGAZZINI, 1915).
* Staphylinid hosts : *Anotylus* and *Oxytelus* (FRANK, 1982); *Platystethus*
* Ethology of the host : Detricolous, coprophagous, common species in Belgium.

Peyritschiella protea THAXTER (Figure 1d).

The fungus was found on *Oxytelus (Styloxis) rugosus* (FABRICIUS, 1775), it was already reported for Belgium by COLLART (1945) and DE KESEL & RAMMELOO (1991) on the same host.
* General habitus : The receptacle consists of a single cell bearing three tiers of superposed cells. The outer cells of the second tier form distal angular projections. The third tier of cells usually bears one or two flask shaped perithecia and numerous short appendages.
* Size of the thalli : 240-295μm, perithecium 100-140μm X 40-60μm, receptacle 135-170μm, appendages 50-150μm, spores 40-50μm X 3-5μm.
* Material examined :
Oxytelus rugosus (FABRICIUS, 1775): (B) Zandvliet, Groot Buitenschoor, 11.IV.1990, slide ADK318(a,b); (B) Logne, 23.IV.1985, slide ADK344; (B) Koksijde, 8-2.VII. 1983, slide ADK345; (B) Neigem, forest, 1-9.VI.1977, slide ADK401; (B) Buzenol, forest, 30.VI-14.VII.1981, slide ADK402; (B) Beernem, Bulskampveld, forest, 14-28.VI.1986, slide ADK403.
* Infection : on abdominal tergites, cephalon and distal edge of the thorax.
* Distribution in Europe : Austria (HULDÉN, 1985); Belgium (COLLART, 1945; DE KESEL & RAMMELOO, 1991); Britain (THAXTER, 1908; BISBY & Mason, 1940); Czechoslovakia (HULDÉN, 1985); Finland (HULDÉN, 1983); France (BALAZUC, 1973-1974); Germany (THAXTER, 1908); Hungary (BANHEGYI, 1944); Ireland (HULDÉN, 1985); Netherlands (MIDDELHOEK, 1943a); Poland (SIEMASZKO & SIEMASZKO, 1932); Sweden (HULDÉN, 1985); Italy, Rumania (FRANK, 1982).
* Staphylinid hosts : Only on Staphylinidae : *Anotylus, Oxytelus* and related genera (HULDÉN, 1985). *Styloxis, Planeustomus, Acrognathus* (BALAZUC, 1974); *Bledius* (FRANK, 1982).
* Ethology of the host : in all kinds of microbiotopes, very common.

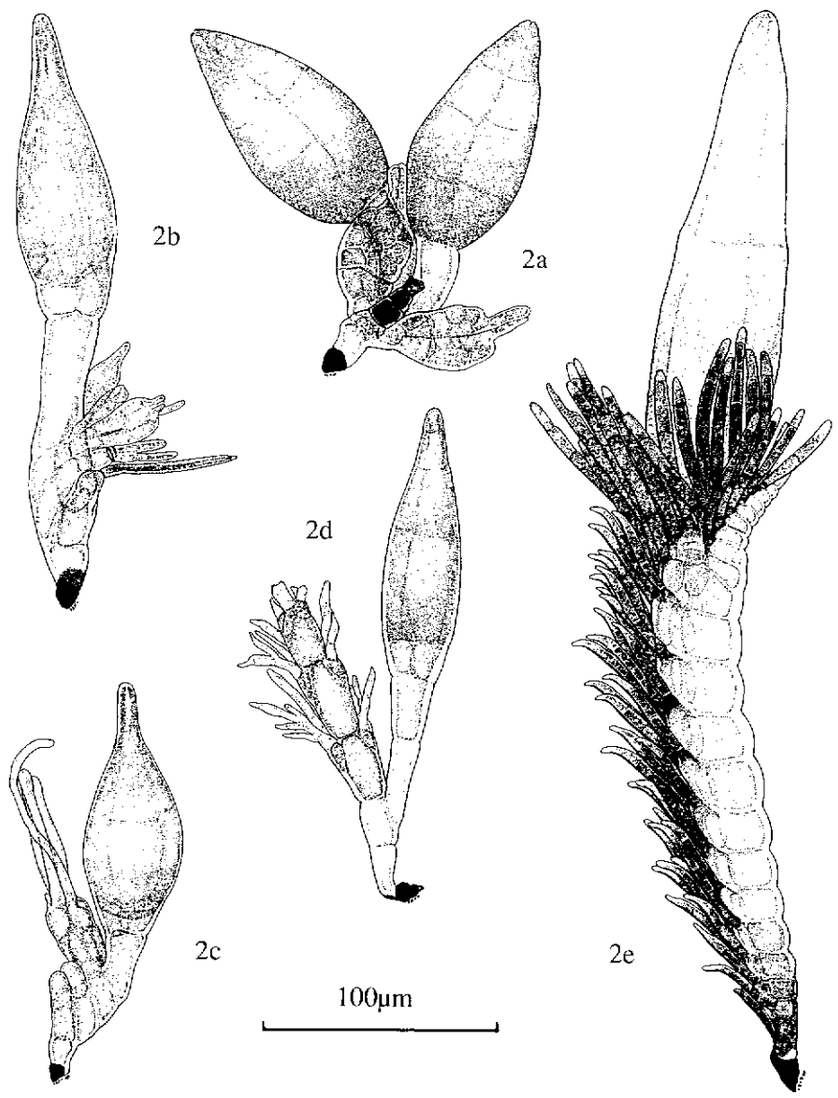

Fig. 2. - 2a. Monoicomyces britannicus THAXTER from abdomen of Atheta (Thinobaena) vestita (GRAVENHORST, 1806); 2b. Monoicomyces californicus (THAXTER) THAXTER from abdomen of Anotylus sculpturatus (GRAVENHORST, 1806); 2c. Monoicomyces invisibilis THAXTER from thorax of Platystethus arenarius (FOURCROY, 1785); 2d. Stichomyces conosomatis THAXTER from pronotum of Sepedophilus nigripennis (STEPHENS, 1832); 2e. Rachomyces philonthinus THAXTER from abdomen of Philonthus rectangulus SHARP, 1874. - scale = 100µm.

Rachomyces furcatus (THAXTER) THAXTER.

Rachomyces furcatus was reported for Belgium by DE KESEL & RAMMELOO (1991) on *Othius myrmecophilus* KIESENWETTER, 1843 and *O. punctulatus* (GOEZE, 1777). *R. furcatus* was recently illustrated in DE KESEL & RAMMELOO (1991, fig. 2d).

* General habitus : Our specimens fit the description given by THAXTER (1896).
* Size of the thalli : total length 250µm-350µm, perithecium 200µm X 55µm, perithecial stalk 50µm-70µm, sterile appendages 100µm-200µm.
* Material examined :

Othius myrmecophilus KIESENWETTER, 1843: (B) Beernem, Bulskampveld, forest, 12-20.VI.1986, slide ADK418.

* Infection : on legs, abdominal segments and pronotum
* Distribution in Europe : Belgium (DE KESEL & RAMMELOO, 1991); Britain (BISBY & MASON, 1940); Poland, Austria (SIEMASZKO & SIEMASZKO, 1932); Germany (SCHELOSKE, 1969); Yugoslavia, Hungary, Sweden, Finland (HULDÉN, 1985); France (BALAZUC, 1973)
* Staphylinid hosts : *R. furcatus* is confined to staphylinid species of the genus *Othius* (FRANK, 1982).

Rachomyces philonthinus THAXTER (Figure 2e).

The fungus was found on several *Philonthus* species.

* General habitus : The receptacle consists of a basal and subbasal cell the latter producing a long and straight secondary axis. The axis consists of approximately 30 cells. The perithecium is situated on the axis at about the 20th cell, the last 5 to 10 cells of the axis form an erect free termination beside the base of the perithecium. All the axis cells bear numerous dark-brown stiff appendages with outwardly curved hyaline tips. The appendages are not obscuring the axis as they are formed on one side it.
* Size of the thalli : 425-510µm, perithecium 175-210µm X 50-75µm, appendages 20-100µm.
* Material examined :

Philonthus varians PAYKULL, 1789.: (B) Koksijde, dunes, 8-2.VII.1983, slide ADK346 (a,b,c); (B) Koksijde, dunes, 22-29.VII.1983, slide ADK347; (B) Koksijde, dunes, 17-24.VI.1983, slide ADK348; (B) Koksijde, dunes, 27.V-03.VI.1983, slide ADK349 (a,b,c); (B) Koksijde, dunes, 20-27.V.1983, slide ADK350 (a,b).

Philonthus rectangulus SHARP, 1874: (B) Erpent, 5-12.VII.1984, slide ADK355; (B) Oostende, in garden, 13-20.VI.1987, slide ADK356; (B) Ottignies, 2.VIII.1980, slide ADK357.

Philonthus fumarius GRAVENHORST, 1806: (B) Wemmel, 29.VI.1987, slide ADK358.

Philonthus fimetarius (GRAVENHORST, 1802) (syn. *P. rigidicornis* GRAVENHORST, 1802): (B) Werbomont, 13.VI.1986, slide ADK359.

* Infection : on abdominal segments, sternum, cephalon and antennae.
* Distribution in Europe : *R. philonthinus* is a palaearctic species (LEPESME, 1942). Austria (HULDÉN, 1985); Belgium (COLLART, 1945; DE KESEL & RAMMELOO, 1991); Britain (BISBY & MASON, 1940); Federal Republic of Germany

(SCHELOSKE, 1969); Finland (HULDÉN, 1983); France (BALAZUC, 1974); Hungary (BANHEGYI, 1949); Netherlands (MIDDELHOEK, 1943c & 1947); Poland (SIEMASZKO & SIEMASZKO, 1932); Sweden (HULDÉN, 1985); Switzerland (STADELMANN & POELT, 1962).
* Staphylinid hosts : *Philonthus, Amichrotus, Gabrius* (FRANK, 1982).
* Ethology of the host : All *Philonthus* species mentioned are living in various kinds of microhabitats: dung, leaflitter, compost, etc.

Stichomyces conosomatis THAXTER (Figure 2d).

The fungus was found on *Sepedophilus nigripennis* (STEPHENS, 1832)
* General habitus : The receptacle consists of a basal and subbasal cell, the latter usually bearing one perithecium on the side and an appendage on the top. The appendage consists of a series of superposed cells. The lower cells are sterile while the upper cells bear fertile opposite lateral branches on their distal side. *Stichomyces europaeus* MAJEWSKI was found in Poland (MAJEWSKI, 1973) on *Conosoma testaceus* FABRICIUS, 1792; it is closely related to *S. conosomatis* as pointed out by MAJEWSKI himself (1973). Most of our specimens fit the description of THAXTER (1908) although some young thalli have antheridial branchlets which are similar to those of *S. europaeus*. More specimens should be examined to determine wether *S. europaeus* should be placed in synonymy with *S. conosomatis*.
* Size of the thalli : 210-250μm, perithecium 100-110μm x 25-35μm, stalk of the perithecium 70-90μm, receptacle 30-60μm, appendage 100-140μm.
* Material examined :
Sepedophilus nigripennis (STEPHENS, 1832): (B) Raversijde, dune, V.1984, slide ADK431.
* Infection : on pronotum and abdominal tergites.
* Distribution in Europe : Belgium (DE KESEL & RAMMELOO, 1991)
* Staphylinid hosts : Conosoma (THAXTER, 1908), *Sepedophilus pedicularis* (GRAVENHORST, 1802) (DE KESEL & RAMMELOO, 1991).
* Ethology of the host : a rather scarce species living in all kinds of detritus.

Symplectromyces vulgaris (THAXTER) THAXTER.

The fungus was found on *Quedius tristis* GRAVENHORST, 1802 and *Quedius curtipennis* (BERNHAUER, 1908), the latter being a new host.
* General habitus : The receptacle consists of a row three or four superposed cells, it becomes broader towards its distal end. The distal cell (the largest) bears one perithecium and numerous sterile and fertile appendages which obscure the base of the perithecium. The fertile appendages are composed of a series of intercalary antheridial cells, each being septate above and forming a lateral outgrowth. Usually there is only one flask-shaped perithecium with an undifferentiated tip.
* Size of the thalli : 270-350μm, perithecium 160-225μm X 45-55μm, receptacle 100-115μm, appendages (all) 20-100μm, spores 40-50μm X 3-5μm.
* Material examined :
Quedius tristis GRAVENHORST, 1802: (B) Raversijde, dune, V.1985, slide ADK340 (a,b,c).

Quedius curtipennis (BERNHAUER, 1908): (B) Neigem, forest, 09.VI.1977, slide ADK421.
* Infection : On both host species the thalli infect only on the pygidium.
* Distribution in Europe : Belgium (COLLART, 1945; DE KESEL & RAMMELOO, 1991); Britain (BISBY & MASON, 1940); Federal Republic of Germany (SCHELOSKE, 1969); Finland (HULDÉN, 1983); Hungary (THAXTER, 1900); Italy (ROSSI & C. ROSSI, 1978); Netherlands (MIDDELHOEK, 1943b); Portugal (THAXTER, 1908); Spain (THAXTER, 1908; SANTAMARÍA & GIRBAL, 1987); Sweden (HULDÉN, 1985); Yugoslavia (SIEMASZKO & SIEMASZKO, 1932).
* Staphylinid hosts : *Quedius* (FRANK, 1982).
* Ethology of the host : *Q. tristis* is a common species from woodlands, meadows, gardens, etc.

Parasite-host list of Laboulbeniales from Belgian Staphylinidae.

(Based on new records; COLLART, 1945 and DE KESEL & RAMMELOO, 1991)

Family **Peyritschiellaceae**		
Cantharomyces		
C. orientalis Spegazzini	Carpelimus corticinus (Gravenhorst, 1806)	Oxytelinae
	Carpelimus foveolatus (Sahlberg, 1832)	Oxytelinae
C. thaxteri Maire	Carpelimus bilineatus (Stephens, 1834)	Oxytelinae
	Carpelimus rivularis (Motschulsky,1860)	Oxytelinae
C. venetus Spegazzini	Carpelimus rivularis (Motschulsky,1860)	Oxytelinae
Monoicomyces		
M. britannicus Thaxter	Atheta vestita Gravenhorst, 1806	Aleocharinae
	Atheta fungi (Gravenhorst, 1806)	Aleocharinae
M. californicus (Th.) Thaxter	Anotylus sculpturatus (Gravenh., 1806)	Oxytelinae
M. fragilis Scheloske	Ocalea picata (Stephens, 1832)	Aleocharinae
M. invisibilis Thaxter	Platysthetus arenarius (Fourcroy,1785)	Oxytelinae
Peyritschiella		
P. biformis (Thaxter) Tavares	Philonthus umbratilis Gravenhorst, 1806	Staphylininae
P. princeps (Thaxter) Tavares	Philonthus cephalotes (Gravenh., 1802)	Staphylininae
	Philonthus politus Linnaeus, 1758	Staphylininae
P. protea Thaxter	Oxytelus rugosus (Fabricius, 1775)	Oxytelinae
P. dubius (Thaxter) Tavares	Philonthus politus Linnaeus,1758	Staphylininae
Family **Laboulbeniaceae**		
Compsomyces		
C. lestevae Thaxter	Lesteva heeri Fauvel, 1872	Omaliinae
Corethromyces		
C. stilici Thaxter	Rugilus rufipes (Germar, 1836)	Paederinae
	Rugilus similis (Erichson, 1839)	Paederinae
Euzodiomyces		
E. lathrobii Thaxter	Lathrobium elongatum (Linnaeus, 1767)	Paederinae
	Lathrobium multipunctatum (Gravenhorst,1802)	Paederinae
E. capillaris Cépède & Picard	Lathrobium geminum Kraatz, 1858	Paederinae
Idiomyces		
I. peyritschii Thaxter	Deleaster dichrous (Gravenhorst, 1802)	Oxytelinae
Laboulbenia		
L. cristata Thaxter	Paederus littoralis Gravenhorst, 1802	Paederinae
	Paederus riparius Linnaeus, 1758	Paederinae
L. atlantica Thaxter	Lathrobium multipunctatum (Gravenhorst,1802)	Paederinae
L. cafii Thaxter	Callus xantholoma Gravenhorst, 1802	Staphylininae
L. dubia Thaxter	Philonthus cognatus Stephens, 1832	Staphylininae
L. stilicicola Spegazzini	Rugilus orbiculatus (Paykull, 1789)	Paederinae
Rachomyces		
R. philonthinus Thaxter	Philonthus varians Paykull, 1789	Staphylininae
	Philonthus rectangulus Sharp, 1874	Staphylininae

	Philonthus fimetarius (Gravenh., 1806)	Staphylininae
	Philonthus fumarius Gravenhorst, 1806	Staphylininae
	Philonthus marginatus Stroem, 1768	Staphylininae
R. pilosellus (Robin) Thaxter	Lathrobium fulvipenne (Gravenh., 1806)	Paederinae
	Lathrobium geminum Kraatz, 1858	Paederinae
R. furcatus Thaxter	Othius myrmecophilus Kiesenw., 1843	Xantholininae
	Othius punctulatus (Goeze, 1777)	Xantholoninae
Rhadinomyces		
R. cristatus Thaxter	Lathrobium brunnipes (Fabricius, 1792)	Paederinae
	Lathrobium castaneipenne Kolenati,1846	Paederinae
	Lathrobium fulvipenne (Gravenh., 1806)	Paederinae
	Lathrobium geminum Kraatz, 1858	Paederinae
Stichomyces		
S. conosomatis Thaxter	Sepedophilus nigripennis (Stephens, 1832)	Tachyporinae
	Sepedophilus pedicularis (Grav.,1802)	Tachyporinae
Symplectromyces		
S. vulgaris Thaxter	Quedius tristis Gravenhorst, 1802	Staphylininae
	Quedius mesomelinus Marsham, 1802	Staphylininae
	Quedius nitipennis Stephens, 1832	Staphylininae
	Quedius curtipennis (Bernhauer, 1908)	Staphylininae
Teratomyces		
T. philonthi Thaxter	Gabrius nigritulus Gravenhorst, 1802	Staphylininae

Discussion

Some species we found on Staphylinidae have also been reported on Carabidae. *Euzodiomyces lathrobii* THAXTER was reported on *Patrobus atrorufus* STROEM in areas with heavily infested *Lathrobium brunnipes* (FABRICIUS, 1792) (SCHELOSKE, 1969). The accidental infection of *P. atrorufus* implicates that the host specificity might not be controlled entirely by immunological factors. We have a strong reason to believe that the host specificity and the nutritional requirements of the fungus are not so strongly linked. The nature of these 'accidental' infections should be studied more thoroughly. The potential host spectrum of the parasite might be much larger than we believe.

We observed that several species of a parasite genus were recorded on 2 or more hostsubfamilies. We found *Monoicomyces* on *Atheta, Anotylus, Ocalea* and *Platysthetus. Atheta* and *Ocalea* belong to the *Aleocharinae* and *Anotylus* and *Platysthetus* belong to the *Oxytelinae*. From our data we conclude that *Aleocharinae* and *Oxytelinae* are related. The fact that *Monoicomyces (Peyritschiellaceae)* is confined to the Staphylinidae consolidates our conclusion. The close relationship we presume between *Aleocharinae* and *Oxytelinae* corresponds also with the parasite-host list of FRANK (1982). In the same way we conclude that *Xantholininae, Paederinae* and *Staphylininae* are related as they all can be infected with *Rachomyces*. The relationship between these three subfamilies was already indicated by FRANK (1982).

The idea of using the Laboulbeniales-Staphylinidae associations for the investigation of the phylogeny of Staphylinidae was recently proposed by FRANK (1982). The classification and taxonomy within the Laboulbeniales is, since their discovery, relatively stable. The classification concepts, mainly from THAXTER, are based on antheridial, perithecial and receptacle characteristics. This classification and the large number of species known from Staphylinidae makes phylogenetic conclusions, based on parasite-host relationships, acceptable. To make further conclusions on phylogeny of Staphylinidae with the parasite-host list presented in this paper would be premature.

The parasite host lists given by several authors (STADELMANN & POELT, 1962; SCHELOSKE, 1969; FRANK, 1982; HULDÉN, 1983) show that the Staphylinidae are a relatively well studied group. The more parasite species are found the more the parasite host list will be able to provide information concerning phylogeny and insect-fungus relationships.

A lot of new potential parasite species on Staphylinidae are still to be found in Belgium. In search for clues to phylogeny of host and parasite it is important that floristic research continues.

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Addendum (January 1992)

Monoicomyces californicus (TH.) THAXTER was recently placed in synonymy with *M. invisibilis* THAXTER by SANTAMARIA, S., BALAZUC, J. & TAVARES, I. (1991), Distribution of European Laboulbeniales (Fungi; Ascomycotina) an annotated list of species. Treballs de l'Institut Botanic de Barcelona XIV: 1-123.

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Interactions comportementales entre la Fourmi Lasius flavus (Formicidae) et le Coléoptère myrmécophile Claviger testaceus (Pselaphidae). II. Fréquence, durée et succession des comportements des ouvrières

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Summary

Behavioural Interactions between the Ant Lasius flavus *(Formicidae) and the Myrmecophilous Beetle* Claviger testaceus *(Pselaphidae). II. Frequency, Duration and Sequence of the Workers' Behaviours.*

Licking and biting are the most frequent behaviours of the Lasius flavus *workers towards the guest beetle,* Claviger testaceus. *These behavioural units, together with regurgitation, take up most of the workers' time. Taking into consideration the small surface they occupy, the mouthparts and trichomes are the beetle's body parts which are the most involved. The licking and biting of these parts appear to be due to the secretion of the myrmecophile's labral and Wasmann glands.*

The duration of the licking of the various parts of the Claviger*'s body, where no multiple glands emerge, significantly correlates with the number of isolated type B glandular units in the licking area. The secretion of these glands probably induces the worker's licking behaviour.*

The workers' behaviours follow each other in a probabilistic way. The statistical significance of their transitions suggests their immediate causality: biting follows licking; the workers transport the Claviger *after having bitten it; the flexion of the gaster towards the* Claviger *follows the biting of the trichomes; the workers' regurgitation onto the* Claviger *occurs only after the licking of the beetle's mouthparts or trichomes, thus suggesting the releasing role of the secretions of the labral and Wasmann glands. The frequency of the workers' self-grooming activity increases after regurgitation. When there is a rest period it follows self-grooming and indicates the end of an interaction sequence.*

The duration of the licking of the Claviger*'s mouthparts does not influence the nature of the worker's subsequent behaviour and does not correlate with the duration of subsequent regurgitations. However, the regurgitation rate (the ratio of the number of regurgitations to the number of licking sessions on mouthparts or trichomes), measured during a relatively long period of time, is sufficiently stable to allow eva-*