LITTLE SACS FULL OF SURPRISES

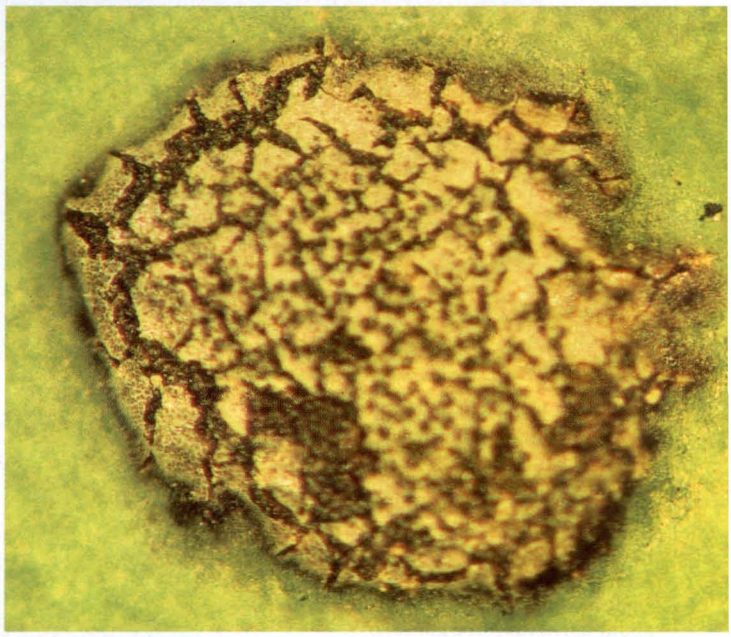
Looking at the ascomycetes – part of the intriguing world of our indigenous fungi.

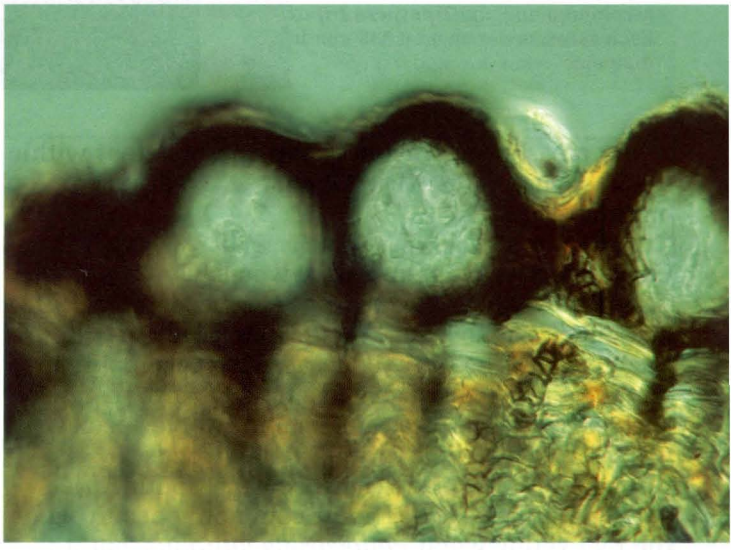
*by **Alan Wood**, Agricultural Research Council, Plant Protection Research Institute, Stellenbosch*

The ascomycetes are the largest and most diverse major group of fungi, varying greatly in size and form. Approximately 47 000 species have been described, although it is estimated that there may be between 600 000 and one million species in existence. They have the common character of producing sexual spores (called ascospores) in a structure called the ascus (plural asci - the word is derived from the Greek word 'askos' meaning a sac). These fungi vary greatly in life styles. They can be soil saprophytes (decomposers), coprophyllic (specialized in decomposing dung), live on leaf or root surfaces of plants, live within plants (endophytes), form mutualistic symbioses like mycorrhizae and lichens, or be pathogenic (causing disease) on plants, animals and other fungi. Many of the most destructive pathogens of crops belong to this group. They inhabit all parts of the earth, occurring in the oceans, freshwater lakes and rivers and on all continents and islands.

There are many indigenous species of ascomycetes that are parasitic on South African plants, although knowledge about them is severely limited. Being generally small they tend to be ignored; this is unfortunate as they are beautiful in structure and deserve closer inspection. The last checklist of fungi recorded from South Africa was published in 1950* and listed 2 874 species of ascomycetes (including lichens). This total however includes non-indigenous crop and horticultural plant pathogens, as well as many species of which the sexual spore stage is unknown. It is also a gross underestimation of the actual numbers present. In this work, Doidge states that 'thousands of specimens of South African fungi have been collected and named, but the mycological work so far accomplished can only be regarded as a foundation for further research.' Little was known about the interactions and effects of our fungi on our plants, be it mutualistic or parasitic, and to a large extent, the situation is exactly the same today as it was then. Basic information about their seasonal prevalence, distribution, host range and life cycle, is scarce.

The saying that fleas have smaller fleas is very true. The Cape sumach (*Osyris compressa*, formerly known as *Colpoon compressum*) is a root parasite of other plants, but it, in turn, is parasitized by a fungus ***Diplochorella amphimelaena***. Small, thickened black spots of 2-3 mm in diameter on both sides of the plant's leaves are actually a compact carpet of tiny round ascocarps. These spots have a silvery covering, which is the dried epidermis of the plant's leaves, through which the ascocarps erupt. Each ascocarp is about 0.12 mm in height and 0.09 mm in width, within which a number of asci produce two-celled spores each 0.012 mm long. Although nowhere common, this fungus has been recorded from throughout the distribution of its host plant. It tends to occur more readily in wetter areas, and is very rare





Top **Fruiting bodies of the ascomycete fungus *Diplochorella amphimelaena* on a leaf of *Osyris compressa*. Each small dark spot is the opening of a tiny flask-shaped ascocarp. The whole body is about 3 mm in diameter.**
Below **A cross-section through three ascocarps of *Diplochorella amphimelaena*, within which can be seen asci each with eight two-celled ascospores. Each ascospore is about 0.012 mm long.**

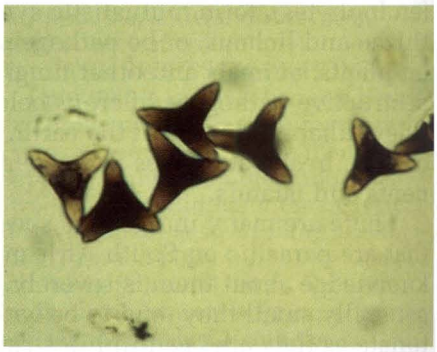
So, naturalists observe, a flea
Hath smaller fleas that on him prey;
And these have smaller fleas to bite 'em,
***And so proceed* ad infinitum.**

Jonathan Swift,
On Poetry; A Rhapsody

ONE GENUS OR TWO?

Our yellowwoods are sometimes divided into two genera - *Afrocarpus* (represented by the Outeniqua yellowwood *Afrocarpus falcatus*) and *Podocarpus* (represented by *P. elongatus, P. henkelii* and *P. latifolius*). This is on the basis of the fruit which is borne on scaly or leafy axilliary branchlets in *Afrocarpus* and on naked axilliary branchlets in *Podocarpus*. Most botanists however, still call the Outeniqua yellowwood *Podocarpus falcatus*, and there seems to be strong feelings about which is correct. Do any readers have a preference? Please write to the editor (address on p. 49) and let us know.

Above **Fruiting bodies or ascocarps of the ascomycete fungus, *Corynelia uberata* on a leaf of *Podocarpus latifolius*. Each ascocarp is about 1 mm long.**
Right **Two asci of *Corynelia uberata* each with eight ascospores. The upper right has mature ascospores, each one about 0.012 mm in diameter.**
Far right **Five ascospores of the ascomycete fungus *Tripospora tripos*. Each ascospore is about 0.028 mm in diameter.**



in dry areas, occurring on leaves and branches within the host bush rather than be exposed to drying on the outermost leaves.

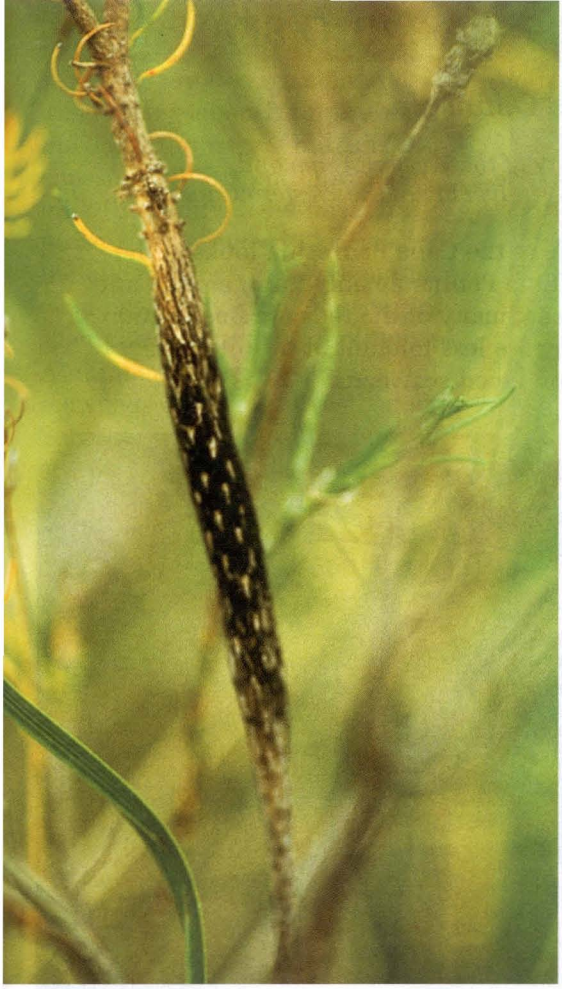
Coryneliaceae fungi on yellowwoods

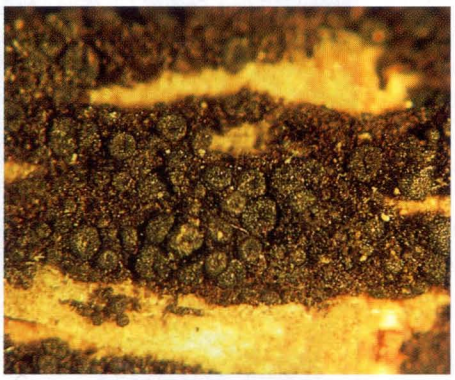
The yellowwoods, *Podocarpus* (see accompanying box), are hosts to a very interesting family of ascomycetes, the Coryneliaceae. This cosmopolitan family of fungi has seven genera with thirty-eight species, of which three genera and twelve species occur exclusively on various yellowwoods throughout the world. The species in South Africa are ***Corynelia uberata*** (most commonly occurring on the real yellowwood *Podocarpus latifolius*, but it is also recorded from *P. elongatus, P. henkelii* and *P. falcatus*), ***Tripospora tripos*** (usually found on large specimens of the Outeniqua yellowwood *Podocarpus falcatus*, but also recorded from *P. elongatus*) and ***Lagenulopsis bispora*** (recorded from *P. elongatus* and *P. latifolius*). One other fungal species of the same family has been recorded in South Africa, namely ***Coryneliospora fruticola***, which parasitizes the fruits of the Cape beech *Rapanea melanophloeos*.

The most common of these species is *Corynelia uberata*, which is found wherever yellowwoods occur in South Africa especially in moist forests, and does not appear to harm its hosts. The black fruiting bodies, the ascocarps, usually appear on the undersides of the host's leaves in small round clusters of up to fifty, each cluster up to 4 mm in diameter. Each of the ascocarps is flask shaped, about 1 mm in length, 0.4 mm in diameter at the base and 0.2 mm in diameter at the narrowest part of the neck. Within the base of each ascocarp are the asci packed like sardines in a can, each one producing eight round ascospores which are approximately 0.012 mm in diameter. In favourable environmental conditions these spores are released through the neck of the flasks, to disperse and infect new leaves. *Corynelia uberata* is also of historical interest as it was one of the earliest indigenous pathogenic fungi collected in South Africa, having been collected by Thunberg in 1772 at Grootvadersbosch in the Langeberg near Heidelberg, Western Cape.

Lagenulopsis bispora is very similar to *C. uberata*. It can be distinguished by its longer thinner ascocarps, and the fact that only two spores are produced per ascus (as indicated by its name '*bispora*'). It occurs on small lesions of dead leaf tissue, but as it is generally very rare, it apparently causes no harm to its host. This fungus may be found on the same tree specimens at the same time as *C. uberata*, and careful observation is needed to distinguish between them.

Although the ascocarps of *Tripospora tripos* are similar to those of *C. uberata*, they are produced in two parallel rows which can reach 2 cm in length making it easy to distinguish from the latter. It also produces star-shaped ascospores each with four arms. Also, as stated above, it usually occurs on large mature specimens of the Outeniqua yellowwood *Podocarpus falcatus*, whereas *C. uberata* is seldom recorded from such specimens (*C. uberata* is sometimes found on young saplings of *P. falcatus*).





Far left **A gall caused by the ascomycete fungus *Antennularia egleriana* on an *Erica* stem.**
Left **Close-up of the gall showing the round ascocarps of *Antennularia egleriana*, each one is between 0.22 and 0.35 mm in diameter.**
Above **Asci of *Antennularia egleriana* in various stages of maturity, each with eight two-celled ascospores which are about 0.025 mm long.**

Erica parasite

Another interesting indigenous ascomycete is ***Antennularia egleriana*** which parasitizes a number of genera in the Ericaceae family in Africa. In South Africa it has only been recorded in the south-western and southern Cape, and is quite rare. This fungus causes the stems of its host to thicken as a long gall. This gall becomes black because of a covering of the black ascocarps which are produced abundantly, each round ascocarp is 0.22 mm to 0.35 mm in diameter. Within each ascocarp each ascus produces eight two-celled ascospores each of which is up to 0.025 mm in length. Again this fungus does not appear to damage the host plants, as infected branches continue to grow and flower as vigorously as uninfected branches.

Our indigenous fungi are as worthy of wonder as our plants and animals. When you are out and about looking at plants, look a little closer - there is a whole new world waiting to be discovered.

About the author
Alan Wood is a plant pathologist employed at the Weed Pathology Unit of the Agricultural Research Council – Plant Protection Research Institute.
He is involved with the biological control of alien weeds with the use of fungi. To find out more about his work, visit the website www.arc.agric.za.

* E.M. Doidge (1950) *Bothalia* 5, pp. 1-1094.

WHAT DOES THAT MEAN?

ascocarp the fruiting body of all ascomycete fungi consisting of an aggregation of hyphae surrounding the **asci**.
ascospores sexual spores.
ascus (plural **'asci)** a sac-like structure within which the ascospores are produced.
cosmopolitan describing species that have a worldwide distribution and are not restricted to specific areas in contrast to endemic species.
epidermis the outermost cells of the plant body.
fungi a group of multicellular organisms that are neither animals, nor plants.They obtain food by absorbtion as opposed to ingestion (animals) or photosynthesis (plants).
hyphae a branched filament many of which make up a fungal mycelium, the vegetative body of most fungi.
lichen a mutual relationship between an alga and a fungus where neither can survive without the other.
mutualism an intimate relationship between two or more living organisms that is beneficial to all participants (e.g. a lichen).
mycorrhiza a mutualistic association between a fungus and the roots of a plant.
parasitism a close relationship between two different species in which one, the **parasite**, benefits from the other, the **host**, by obtaining food and/or shelter at the expense of the other.
pathogens living organisms that cause disease.
saphrophyte an organism that uses dead organic material as food, commonly causing its decay.
spores a general term for reproductive structures in fungi, bacteria, algae and non-seed plants (mosses and ferns).
symbiosis an intimate relationship between two or more living organisms. It may be synonymous with **mutualism**, but can also include other relationships such as **parasitism** and comensulism.