“BALLISTIC” FUNGI

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While most fungi do not actively disperse their spores, those that do so have evolved some remarkable mechanisms. This article, in two Parts, will examine the mechanisms used by some fungi to achieve spore dispersal by a “ballistic” method.

PART 1. THE ‘BOMBARDIER’ FUNGUS – *Sphaerobolus stellatus* Tode.

Gardeners that use a mulch of woodchips for landscaping may sometimes find small, pin-head size, dark brown to black objects very firmly adhering to the vegetation and other adjacent surfaces, such as the outsides of houses, windows and cars. These persistent dots are the peridioles or spore masses of the fungus *Sphaerobolus stellatus* Tode. The name; *Sphaerobolus* is from the Greek for ‘sphere thrower’, stellatus = starry.
First described as *Carpobolus* by the Florentine botanist Pier Antonio Micheli (1679-1737) in his work *Nova Plantarum Genera*, it is commonly known as the ‘Bombardier, Artillery or Cannonball Fungus’, since it actively ejects the peridiole, of about 1-1.5 mm diameter the remarkable distances of up to 2 metres high and 5.5 metres distant. It is a cosmopolitan genus in the Northern and Southern Hemispheres and while it is not known if this is its natural range or whether it has been dispersed artificially, it is noteworthy that its lignicolous and coprophilous ecology supports a large number of dispersal scenarios. Animals may have been the major disperser in early times but the international movements of humans and wood products may be more significant today.
S. stellatus is saprophytic on wood chips, dying and decaying wood and herbivore droppings and when temperatures range between 10°C and 20°C with adequate moisture levels, the mature fungus produces a globose sporocarp; approximately 2 mm diameter, erupting from the substrate, or developing from a pallid, surface mycelial layer. The outer surface is cream-buff to ochraeceus, matted tomentose, soon splitting to form 5-7 short stellate lobes. The inner peridial layer is also stellate, attached only to the outer cup lobes at the acuminate points of the layers, more or less translucent, tinged yellow, and surrounding a spherical peridiole sitting in a bath of clear fluid. The two layers are separate and the gaps at the edges allow air between the two layers. (Fig. 1.)

Fig. 1.

At maturity the inner layer suddenly everts, ejecting the dark-brown, sticky but soft spherical peridiole. (Fig. 2.) Flattening somewhat when it hits a surface, it darkens in colour and adheres very firmly when dry.

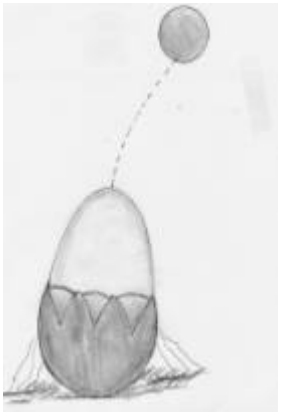

Fig. 2.

The remnant inner peridial layer, inflated and balloon-like, remains attached at the lobe tips and with age the whitish cup collapses. (Fig. 3)

Fig. 3.

The inner peridial layer consists of two layers; an upper layer of radially orientated palisade cells that adhere perpendicular to a lower tangentially orientated hyphal layer. (Fig 4.) While the mechanism that causes the eversion of the inner peridial layer is not completely clear, it has been suggested that the osmotic absorption of water by the layer of radially orientated palisade cells expands them and that this expansion exerts a tension on the resistant underlying hyphal layer. (Fig. 5.) This tension is relieved by the inversion of the peridial layer, which suddenly flips 'inside-out' in about 1/1000 second giving the peridiole, freely floating in the fluid bath, a launch velocity of approximately 5 m/sec. The process is phototropic with the peridiole projected towards the nearest brightest light.

Fig. 4.

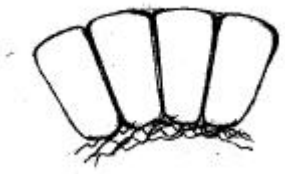

Fig. 5.

The spore mass contains two types of spores, uni-nucleate, thick-walled basidiospores and thin-walled elongated gemmae or asexual spores with two or more nuclei. Germination is triggered by protein digesting enzyme action and temperatures, such as may be found in a herbivore digestive system after eating vegetation with attached peridiole. If not ingested by a herbivore, gemmae can germinate directly on wood or plant debris. The fungus bleaches the substrate when it digests the substrate.

With drought conditions, the landscape use of wood mulch has become increasingly popular and consequently may increase the incidence of *S.stellatus*, which could adversely affect surfaces within range of the ejected peridioles, for when dried, they are very difficult to remove. To minimise possible damage to the surfaces to which they adhere, peridioles should be removed, before they dry, with a stiff water spray but more likely, this is not practical and removal is usually attempted after the peridioles have dried. When this is the case, a high degree of care is necessary since the removal process itself can often damage the substrate, especially painted surfaces on cars. When the glebal masses are on glass surfaces, they can be easily removed by scraping with a razor blade. Peridioles are persistent and have been found to still be viable for up to 11 years and in some cases there may be extensive staining as the fungal masses degrade, usually the stains fade with time, but can be

unsightly.
Prevention and avoidance are the major strategies for control of this fungus since chemicals are ineffective. Some success has been achieved by periodic overlaying with fresh mulch, thereby reducing the light which is important for peridiole discharge. Mulches that contain at least 85% bark are best. Another tactic to minimize this problem in the landscape is to use an alternative form of mulch such as stone, pea gravel, or marble chips in areas directly adjacent to homes, cars, or other surfaces where the risk of damage is the greatest. Although the use of these methods of control means that you won't have the "big-gun" of the fungal world in your yard!