

From 'fire esca' to 'esca of grapevine'

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Summary. The use of tinder ('esca' or 'amadou') prepared from basidiocarps of some bracket fungi, e.g. *Fomes fomentarius* and *Phellinus igniarius* as an easy-to-burn matter goes back to the man's conquest of fire. Archaeological finds, such as fragments of tinder, flint-stones and traces of pyrite carried by the 'Ice man' on his way across the Alps more than 5,000 years ago, bear evidence of the use of tinder in the Neolithic age. In 1926, on the assumption that *P. igniarius* was one of the pathogens of the so-called 'apoplexy' of grapevine, the name 'esca' was given to the disease. For long time, esca was thought to affect old vines only. In the last decades, however, various forms of the disease have been found to be widespread and to cause losses even to young vines. Aetiological studies have shown that esca of grapevine is a complex disease, incited by wilt-inducing ascomycetes (*Togninia*, *Phaeoacremonium*, *Phaeomoniella*) and/or the wood-decaying basidiomycete *Fomitiporia mediterranea*. Since the latter is not a tinder fungus, the advisability of retaining the name 'esca' for the disease is discussed.

Key words: tinder, *Fomitiporia mediterranea*, wood-decay, amadou.

Esca or tinder fungi through the centuries

On 19 September 1991, two tourists from Nuremberg, Helmut and Erika Simon, on a walking-tour through the Alps of Ötztal and Venosta, accidentally discovered the remains of a human body half buried in the glacier of Semilaun, near the border with Austria, at about 3200 metres above sea-level. Their find was destined to arouse enormous scientific interest; for when the 'Ice man' was taken to Innsbruck and examined at the University there, he was found to have lived in the late Neolithic Era, between 3350 and 3100 BC, or more

than 5000 years ago, in the Copper Age (Spindler, 2000; Fleckinger, 2002).

The mummified body of 'Ötzi', as he came to be popularly known, is now preserved in the Archaeological Museum of Bolzano in Italy. For the first time ever, a great number of specialists of various disciplines from all over the world had an opportunity to examine and study scientifically not only a mummified body from such an early date, but also the clothes he was wearing and the tools he had with him. These investigations are still in progress. In 2001 it was established that the immediate cause of Ötzi's death had been an arrow that had lodged in his shoulder. The loss of blood resulting from this wound deprived the man of his strength and he fell, to be gradually covered by snow and ice. Incidentally, by a singular coincidence, Helmut Simon, one of the pair who originally discovered

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him, was swept away by a snow avalanche during an excursion he undertook in the Salzburg Alps on October 2004, and his body was found some days later in a glacier: he had met the same fate as Ötzi.

At this point it may be asked what the Ice man has got to do with *esca*. The answer lies in the objects he was carrying with him at the time he died, while he was making his way across the Alps. Among the articles of his equipment, the man was carrying some dry objects made from the fruit-bodies of two bracket fungi.

Two of these fungal objects were whitish corky structures, one roughly conic, the other sphaeroidal and ring-shaped, about 5 cm thick, each bored through and threaded on a leather strap. They were recognised as portions of basidiocarps of the birch polypore *Piptoporus betulinus* (Bull.) P. Karst. (Peintner *et al.*, 1998). On the use Ötzi may have made of this fungus there has been much discussion, with disagreeing opinions being expressed (Chapela and Lizon, 1993; Peintner *et al.*, 1998). In view of the way in which it burns it seems unlikely that the birch polypore was used as tinder to make fire; a more probable hypothesis is that it served him for medical or spiritual purposes (Thoen, 1982; Capasso, 1998).

The other fungal objects found, which looked like small clumps of a brown or blackish matter of a wade-like consistency (Fig. 1), were enclosed together with three flint-stone tools in a pocket of a 2-metre-long girdle pouch made of hide and leather. This material was identified as tinder prepared from basidiocarps of the hoof fungus, *Fomes fomentarius* (L.) Fr. (Pöder, 1993; Pöder *et al.*, 1995). Traces of pyrite were found on this material, indicating that it had in fact been used by the Ice man to kindle a fire or a torch by striking a spark.

The find of tinder among the belongings a prehistoric traveller was carrying along with him shows that in the fourth millennium B.C. it was not only known what was the best fungus to produce tinder, but also what was the way to prepare it. But in any case carpophores of *F. fomentarius* have been found together with fragments of pyrite and flint in sediments dating back to about 6000 B.C., bearing witness to the vital role of this fungus in man's conquest of fire, and in the evolution of primitive man (Ramsbottom, 1969; Thoen, 1982).

The genus *Fomes* (Fr.) Fr. derives its name from the Latin word *fomes*, meaning appropriately

enough kindling-wood, or tinder (hence in English, to foment), and the specific epithet *fomentarius* likewise refers primarily to the use of this fungus as tinder, but can also be used to refer to bandages or dressing for wounds (Tacitus speaks of *vulneribus fomenta*, meaning fomentations or bandages for wounds). *Esca* is also a Latin word; it means food, aliment, bait, and, figuratively, a bait, lure, or allurement.

Fomes fomentarius (Fig. 2) is indeed the true tinder ('amadou' or 'esca') fungus, used to make fire. It grows, and decays the wood, on the trunks of beech and other woody angiosperms such as birch, oak, poplar, maple, alder, and some fruit trees, and has a world-wide distribution (Ryvarden and Gilbertstone, 1993, 1994; Schwarze, 1994). The basidiocarps of other species of *Fomes* and of other genera of *Hymenochaetales* and *Polyporales*, for example the false tinder-fungus *Phellinus igniarius* (L.) Quél. (Fig. 3) and *Daedalea quercina* (L.) Pers., were also used to make tinder, but this was of lower quality. The bracket-shaped fruit bodies and portions of wood decayed by these fungi burned slowly, and were used to keep fires aglow without a flame.

An empirical knowledge of 'amadou' or 'esca' fungi and the uses to which they could be put thus goes back to prehistoric times, from which it was transmitted to Greek and Roman antiquity, being attested by various classical authors such as Theophrastus in the fourth and Hippocrates in the fifth century B.C., and by Pliny the Elder in the first century A.D. This knowledge was handed down to the Middle Ages and the early modern era. The first descriptions and depictions of these fungi, though the precise species referred to often remain uncertain, go back to the Renaissance, which was a time when ever greater attention was given to the world of Nature.

These fungi and their uses were mentioned among others by Paul of Aegina (Paulus Aegineta) in 1534. A painting (No. 127 in the *Iconographia plantarum*) of the renowned Italian naturalist Ulisse Aldrovandi (1522–1605) dating from around 1560 purports to depict a '*Fomes seu esca fungi species quae oritur ex nodo mali arboris...*' (A *Fomes* or *esca*, a fungal species born on the wood of an apple tree...), though in fact what seems to be depicted is not a *Fomes* but probably a *Phellinus*. Aldrovandi may however have seen a detached

specimen of the esca fungus, and imagined it growing vertically, like a *Ganoderma* (Govi, 1999). Out of the 18 groups of fungi established by Andrea Cesalpino in the first attempt towards a natural classification of plants (Cesalpino, 1583), one includes the *Igniarii* or 'esca' fungi.

Knowledge of fungi, including the *Polyporaceae*, progressed substantially with the development of modern science, starting from the early scientific observations made by Prince Federico Cesi, the founder of the first scientific Academy in the world (Accademia dei Lincei, founded 1603), and also the first to apply Galileo's microscope to the observation and depiction of the fine details of living organisms. Cesi left about 1400 magnificent water-colour paintings of plants and fungi, including among the latter bracket and hoof-shaped polypores (Graniti, 2005; Pegler, 2001; Freedberg, 2002). Even the minute pores of the basidiomata were exactly drawn.

Further advances were made with the development of mycology as a science, starting with the fundamental work of Pier Antonio Micheli *Nova Plantarum Genera* (Micheli, 1729) where *Fomes* and related polypores endowed with perennial carpophores were classified in a distinct taxonomic group, onwards.

Such advances also had repercussions on the practical applications to which tinder was put.

Over the centuries, the preparation of esca tinder mostly started with a search in the forest for the characteristic hoof- or bracket-shaped fruiting bodies; the resupinate forms were also sought after, since they yielded esca of the first quality. From the basidiocarps so gathered, the part adjacent to the matrix, the corky or woody cortex and the layers of poroid hymenophores were removed with a knife. The middle part of the pileus, or context, i.e. the spongy hyphal mass between the surface and the subhymenium, was dipped in water, beaten on a stone with a wooden pestle, then again soaked and beaten a number of times until it was reduced to thin, soft yellow-brown strips or sheets that were dried in the sun and stored under dry conditions.

Until about a century ago, the esca industry was fairly widespread in the mountain areas of various parts of Europe, especially where beech woods were common. In some of these areas esca tinder continued to be produced as a cottage industry as late as the First World War (Massa, 1918; Thoen, 1982).

To use esca to strike fire with a flint and pyrite or steel, the raw esca prepared as described above was further soaked in a solution of saltpetre (potassium nitrate) or some other nitrogenous compound (which in prehistoric times may also have included urine); then it was dried in the sun and made to crumble until it became fibrous or fluffy, like cotton batten. This common type of esca was used mainly to light the fire in household hearths. With the invention of fire-arms, esca was also used to prepare the fuses of portable guns fitted with a flint, and for fuses of mines and in fireworks.

Esca of the highest quality and prepared with the greatest care and expense had a uniform consistency and was felty and soft, velvety and suede-like to the touch, somewhat similar to buckskin. This type of esca was highly hydrophilous, but unlike cotton it did not fray. It was used in the manufacture of a range of articles of common use, clothing and decorations, but also as absorbent material for use by draughtsmen and painters.

The most important use to which this type of esca was put, however, was in the field of medicine and surgery, as an absorbent and haemostatic dressing. For this purpose the esca product was boiled several times before use and could be soaked in an antiseptic or coagulant substance. This so-called 'surgeon's agaric' or touch-wood (*Fungus chirurgorum*) was kept in chemists' shops and used as a styptic by surgeons, dentists and barbers who applied it to wounds to stop haemorrhages. Several other medical applications of esca were developed over the centuries in various parts of the world (Thoen, 1982; Pöder and Pumpel, 1998).

Though 'esca' fungi are in reality pathogenic organisms found on trees, for a long time they were studied by mycologists, who were more interested in the fungi themselves than in the diseases they caused. Plant pathologists on the other hand mostly studied the wood decay and losses caused by these fungi to trees and timber, rather than the pathogens. This was also the case with 'esca of grapevine'.

The esca disease of grapevine

The esca disease of grapevine (Fig. 4) may be as old as vine cultivation itself. References to esca-like symptoms are found in several ancient Greek and Latin works. A greater descriptive accuracy is



Fig. 1. Fragments of tinder carried by the Ice man. Photo Augustin Ochseneiter, Fotoarchivio Museo Archeologico dell'Alto Adige, Bolzano, Italy (www.iceman.it).



Fig. 2. Carpophore of the true esca fungus, *Fomes fomentarius* on a beech tree. Photo Gilberto Govi, Bologna, Italy.



Fig. 3. Carpophore of the false esca fungus, *Phellinus igniarius* on a willow tree. Photo Annarosa Bernicchia, Bologna, Italy.

found in mediaeval works, e.g. the writings of Ibn al-Awam and Piero de' Crescenzi (13th century). In more recent times, esca was associated with wood-decay (white rot) and was considered to be a disease affecting old vines.

Research on the aetiology of esca started towards the end of the 19th century in France (Ravaz, 1898, 1909; Viala, 1926) and led to the conclusion that the causal agents were two basidiomycetes, *Phellinus igniarius* and *Stereum hirsutum* (Willd.) Pers., although this could not be shown by pathogenicity tests. Since *P. igniarius* was a well-known esca fungus, and the trunks of esca-affected vines consistently showed white, the name esca was also given to the rot disease (Viala, 1926). The work of L. Petri (1912) (Fig. 5) who first observed a brown wood-streaking condition in vines affected with a decline in Sicily, and who successfully reproduced these internal symptoms with two *Cephalosporium*- and *Acremonium*-like fungi, was practically ignored by plant pathologists (Dubos and Larignon,

1988; Galet, 1991) until the second half of the 1990s (Mugnai *et al.*, 1999).

In this latter period, some hyphomycetes consistently isolated from the woody tissue of vines showing esca symptoms in various parts of the world have



Fig. 4. Typical symptoms of esca in the leaves and the wood of an old grapevine. The leaves show the typical tiger-like necrosis and chlorosis, and the trunk shows white rot. Photo Laura Mugnai, Firenze, Italy.



Fig. 5. Lionello Petri (1875-1946) in his laboratory at Florence, Italy.

been referred to the genera of *Ascomycetes* anamorphs *Phaeomoniella* Crous *et al.* W. Gams (Crous and Gams, 2000) and *Phaeoacremonium* W. Gams *et al.* (e.g., *Pm. aleophilum* W. Gams *et al.*, anamorph of *Togninia minima* [Tul. *et al.* C. Tul.] Berl.) (Crous *et al.*, 1996; Mostert *et al.*, 2003). It has also been found that among the wood-rotting fungi most closely associated with esca-affected vines, *Stereum hirsutum* had only a marginal role, and that the wood decay long thought to be caused by *Phellinus igniarius* (Chiarappa, 1959) was actually caused by species of *Fomitiporia* Murrill, and in the European vine-growing areas, particularly by *F. mediterranea* M. Fischer (Fischer, 2002) (Fig. 6).

As a consequence the conviction gradually took hold that esca of grapevine was in fact an association of at least two distinct diseases, or was in any



Fig. 6. Carpophore of *Fomitiporia mediterranea* on an old trunk of grapevine. Photo Claudio Ciccarrone, Foggia, Italy.

case a disease complex in which different pathogenic factors and microorganisms concurred (Mugnai *et al.*, 1999; Graniti *et al.*, 2000). This led to specific syndromes ('Petri disease') being distinguished within the complex framework of grapevine declines, and to research being carried out to determine the effect of inoculating individual fungi in healthy vines, and to study the mixed infection of these fungi in all possible combinations, as well as the interaction between them (Sparapano *et al.*, 2000, 2000a, 2001).

The results of these researches have shown that the fungi involved in this complex aetiological picture individually reproduce some of the symptoms of esca, and also that some of these external or internal symptoms are similar and difficult to distinguish from each other. It has also been shown that infections by vascular pathogens (ascomycetes) may originate in mother vines and that infections of wood-decaying fungi can start very early in the life of a vine. Numerous observations also attest that vines can show the foliar symptoms of esca even in the absence of apparent white rot in the trunk.

The name 'esca' for the disease, which before then had been known by a variety of names (feuille-tage, apoplexie in France; carie, apoplessia in Italy), was proposed by Viala (1926) when the disease was associated with *Phellinus igniarius*, one of the fungi called esca in several countries.

The question thus remains whether it is still legitimate to give the name esca to those grapevine diseases showing symptoms of decline, wilt or apoplexy, which are associated with vascular fungi only, or whether the name esca should be limited to syndromes involving wood decay, both those caused by *F. mediterranea* only and those produced by mixed infections of wood-rotting and vascular fungi, which in vineyards are the most common.

In conclusion, since *F. mediterranea* is not a tinder fungus, and since moreover its resupinate basidiomata do not commonly occur on grapevines, a paradox arises, for the grapevine disease known as esca turns out to be most closely associated with a non-tinder fungus.

The name esca should nevertheless be preserved for this disease (as a *nomen conservandum*), also because *F. mediterranea* is an efficient wood-rotting agent, a feature that this species shares with the true 'esca' fungi.

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