This paper complements an earlier one on the folklore of gasteromycetes (Spoonier & Læssøe, 1994).

Culinary Uses

Puffballs, especially the Giant Puffball (Calvatia gigantea), have long had culinary value, despite the comment by Gerard (1597) that ‘Pusse-balls are no way eaten’. They were, for example, evidently well known to the Greeks and Romans (Buller, 1915), and unsuccessful attempts at cultivation were carried out in Denmark more than 150 years ago (Ramsbottom, 1955). Most species are edible in their young stages before the spores develop, and their use in this condition remains widespread. Fries (1986), for example, recommends Lycoperdon germinatum (= perlatum, Fig 1), amongst others, for drying and serving with oil, salt and pepper. Indeed, the Giant Puffball came 7th in a recent poll of ‘Your Top Twenty Twenty Fungi’ (Legg, 1990). However such use is not universal. The North American Iroquois, for example, according to one source, referred to puffballs as ‘Devil’s bread’ (Burk, 1983). According to Smith (1981), some species of Calvatia and Lycoperdon have been implicated in ‘violent gastrointestinal upsets’, though this may result from eating specimens which are nearing maturity.

In Central Africa, at least in Zambia and Malawi, puffballs are recognised and have received folk names but they have no particular significance (Pierce, 1981; Morris, 1984). However, various species of Calvatia, Langemanniina, Lycoperdon and Vaseellum are used as food items in some areas (Rammelloo & Walley, 1993). In North America, puffballs were apparently an important food commodity amongst Indian tribes. For example, the Zuñi used large quantities of puffballs, both fresh and also dried for use during the winter months (Burk, 1983). They were also generally popular used in soups. In Mexico, a species of Lycoperdon is eaten by the Tepeutu of Durango (Gonzalez, 1991).

Earthballs (Scieroderma spp.) have been used as adulterant for truffles and as a condiment but, nevertheless, are known to contain toxins (Lincoff & Mitchell, 1977). They should never be consumed in more than the tiniest quantities.

Stinkhorns and their allies have little culinary value. However, the unexpanded eggs and the spongy stipes of some species of Phallus are edible and have been used in salads. In places, the eggs are pickled, and in Germany they are incorporated into sausages and are also sold as a kind of truffle (Dickinson & Lucas, 1979). Similarly, in North America several species are regarded as edible in the egg stage (McIlvaine, 1990). In China, Lysurus mokusin is eaten (Berkeley, 1857), and is said to be a great delicacy (Dickinson & Lucas, 1979). Perhaps the most important species in this respect is P. indusiatus. This is considered an excellent edible fungus by the Chinese (Liu, 1984b; Boa, 1988), and is cultivated for this purpose, both indoors and outdoors, in parts of China. Dictyophora rubrovelutina is also considered an excellent edible fungus in China (Liu, 1984b).

In New Zealand, the gelatinous volva of species of Ileodictyon is eaten (Berkeley, 1857), the fungus being called by the Maoris ‘Thunder dirt’ (Steele, 1888). Clathrus ruber (Fig 2) is also said to be edible in the egg stage (Marchand, 1976), although an early account by Barla (1858) describes a case of poisoning by this species. Cooke (1862) also gives an alarming report of the development of violent convulsions and loss of speech in a young girl after eating this fungus. It reportedly took ‘some months’ before she was fully recovered. Several species of phalloid, including P. rubicundus and Dictyophora multicolor, are also regarded as poisonous (Liu, 1984a, b). It is also reported by Oso (1976) that the Nigerian people in general regard stinkhorns as poisonous.

Medical Uses

Uses for puffballs and stinkhorns, and other gasteroid fungi, in medicine are many and wide-
spread. Use of the fruitbodies themselves has a long history, but drugs and other active components have comparatively recently been isolated from some species.

Folk-medicine: puffballs, earthstars and bird's-nests

The most frequent use of puffballs is probably as a wound dressing. The giant puffball has been used to form a surgical dressing (Rolfe & Rolfe, 1925), and the powdery spore mass of many species is a useful and effective styptic. Such use was widespread in Europe and North America but also found in India (Rai et al., 1993). According to Swanton (1917), larger puffballs were at one time commonly kept in farmhouses and cottages in West Sussex, and the custom still lingered on in the season of 1916. The dried and powdered young fruitbodies were used in a similar way by some North American Indians (Burk, 1983). It should also be noted that the inhalation of the spores of puffballs can cause a lung disease known as lycoperdonosis (Henriksen, 1976).

In China, many puffballs and related fungi, including species of *Battarrea*, *Tulostoma*, *Bovista*, *Bovisiella*, *Calvatia*, *Lycoperdon*, *Myco-straum*, *Astraeus*, *Geastrum*, *Pisolithus*, *Scleroderma*, and *Cyathus* are considered as medically important (Liu, 1984a, b; Ying et al., 1987). These are mostly used as a styptic, many also being commonly considered to reduce swelling and to detoxify. Some species are used for throat ailments, and others to reduce fever and coughing, as a painkiller or for stomach ache. Some are believed effective against cancer in mice; indeed, a 100% success rate has been demonstrated for *Lycoperdon pyriforme* against two forms of cancer in white mice (Ying et al., 1987). In Nigeria, *Calvatia cyathiformis* is used by the Yoruba people as a cure for leucorrhoea or 'pneumaturia' [sic]. Fruitbodies are ground up with other ingredients, either herbs or fungi, or 'African black soap', and applied orally or as a wash (Oso, 1977).

The use of *Tulostoma* in North America by the Ramah Navaho to cure leg bone fractures in sheep, by application either as a poultice or as an infusion, was given by Burk (1983). Species of *Tulostoma* are also employed in China to control swellings and bleeding, and to allay fever (Ying et al., 1987). The use by the North American Paiute of *Battarrea* and other puffballs to treat swellings and sores is also given by Burk (1983). In China, *Battarrea* species are used in a similar way, and also to 'relieve internal heat or fever' (Ying et al., 1987). In Namibia, the spores of a species of *Battarrea* are used by the Topnaar people (Van den Eynden et al., 1992). These are rubbed on the skin to treat burns, and are mixed with oils to form a protective skin ointment and a cosmetic.

Other uses to which giant puffballs have been put include treatment of diarrhoea in calves in Finland (Dickinson & Lucas, 1979) and Germany (Brondegaard, 1987), and a similar and current use for *Bovista graveolens* in southern Bohemia was reported by Kotlaba (1955). In North America, the Potawatomi Indians use *Morganella subinornata* as a cure for headaches and refer to it as the 'headache berry' (Smith, 1933; Burk, 1983). Some puffballs, including several Mexican species of *Lycoperdon* and *Vasellum*, have also been reported to have hallucinogenic properties. Heim (1978) discusses two species of *Lycoperdon* which have ritual use in the Taxiacco region, and are also considered to have therapeutic properties. However, despite being used for such purposes, these fungi appear to have no active principles (Ott et al., 1975).

Puffballs and earthstars were used by some North American Indians to prevent infection after severing of the umbilical cord. Another strange use of the spores of earthstars noted by Burk (1983) was to cure discharges from the ear, and puffball spores were similarly used as a remedy for ear ache. Another use of puffballs, as a cure for sprains, was evidently practised in Himalayan areas such as eastern Nepal by the Lepchas (Hooker, 1854). Smouldering fruitbodies were applied directly to the skin. The Lapps have a similar use for *Fomes fomentarius*, the burnt flesh then being covered with a piece of dried puffball (Lysebrotne, 1993).

Some tribes from Madhya Pradesh, India, use species of *Cyathus* (Fig 3) to soothe sore eyes (Rai et al., 1993), but there appear to be no other known medical uses for bird's-nest fungi. These tribes also employ *Astraeus* to treat burns, mixing the spore mass with mustard seed oil to form an ointment (Rai et al., 1993). A similar use for this fungus is found in China (Ying et al., 1987).
part of a preparation to treat leprosy (Oso, 1976).

Some other phalloids are considered to have medical significance in various parts of the world. In China, *Lycoperdon perlatum* is reputed to be a cure for gangrenous ulcers (MacMillan, 1881; Dickinson & Lucas, 1979) and, according to Ying et al. (1987), it has anticancer properties. Also in China, *Simulium gracile* is used for oesophageal cancer and gastritis (Ying et al., 1987). In France, *Clathrus stuck* has, quite without foundation, been suspected of causing cancer, skin lesions, sickness, convulsions and delirium (Dring, 1980; Dickinson & Lucas, 1979). It is referred to in France as ‘Cancreu’ or Cancer (Badham, 1863).

**Modern studies**

The anti-tumour drug ‘Calvacin’ has been extracted from the giant puffball (Beneke, 1963) and other species, notably *Boletellus radicata*, *B. sinensis*, *Pseolithus tinctarius* and *Scierodermum cepa* (Ying et al., 1987). This compound is present only in young fruitbodies and in very tiny quantities, but higher yields are reported from cultures.

**Folk-medicine: stinkhorns**

Stinkhorns appear to have had little medical significance in Britain, although in 1865 they figured prominently in discussions in The Times’ newspaper as a possible cause of cholera and other epidemics (Brondegaard, 1983). However, elsewhere in Europe, and in India and China, stinkhorns have been used in a variety of ways. In the Middle Ages, especially, they were used to treat epilepsy, rabies, kidney problems, gout, rheumatism and bleedings. The effectiveness of *Phallus impudicus* is also noted by Ying et al. (1987). *Phallus rubicundus* is reported by Rai et al. (1993) to be used in Central India against typhoid, and also to ease labour pains. This species is also used in China, but as a treatment for ‘sores, subcutaneous ulcers, scabies, carbuncle and fistula’ (Ying et al., 1987), and to promote healing (Liu, 1984a). The dried and powdered gleba is mixed with oil and applied as an ointment. Species of the closely-related genus *Dictyophora* are used in China as a treatment for dysentery, and dried fruitbodies of *D. multicolor*, immersed in 70% alcohol and applied externally, are employed as a treatment for athlete’s foot. In Nigeria, *Phallus aurantiacus* and other stinkhorns are used by traditional Yoruba doctors as...
More recently, calvatic acid, another active factor with antibiotic and anti-tumour properties, has been isolated from another species, *Calvatia craniiformis* (Umezawa et al., 1975). Another drug complex, cyathin, has been extracted from the bird's nest fungus *Cyathus stratus* (Fig 3) and others. This complex includes seven different compounds (Brodie, 1975) and is antibiotic and bacteriostatic.

**Other Uses**

Puffballs have been put to a variety of practical uses other than the medical and culinary aspects discussed above. It was suggested by Watling (1975) and by Watling & Seaward (1976) that the presence of *Bovista nigrescens* in prehistoric dwellings in Orkney, Scotland and other sites in England could indicate their use as insulation against draughts in buildings. The latter authors also speculated on the use of puffballs in early times as kindling for fires. This use as tinder was given by Cooke (1962) for *Calvatia gigantea*, and, indeed, for puffballs generally according to Gerard & Johnson (1633). Their fruitbodies were also useful for transferring fire from place to place, for which use they were known as 'Lucernarum Fungi' (Gerard, 1597; Gerard & Johnson, 1633). Addition of saltpetre to dried fruitbodies of *Handkea utriformis* (Fig 4) to produce Amadou is also reported by Cooke (1862). Amadou, traditionally prepared from the flesh of *Fomes fomentarius*, is used either as tinder, or in medicine as a haemostatic or for packing under nail margins.

One of the main uses for puffballs, especially *C. gigantea*, was in beekeeping. Fumes, from the smouldering fruitbody placed beneath the hive, calm the bees to facilitate access. Puffballs have been so used in Europe, including the British Isles (Swanton, 1917; Dickinson & Lucas, 1979), and throughout North America (Burk, 1983), and it is a long established practice. The tranquillising properties of the fumes are actually due to an excess of carbon dioxide rather than to any special anaesthetic properties. However, puffballs were at one time employed more generally as an anaesthetic, being successfully used in operations according to Berkeley (1860). MacMillan (1861) states in prosaic fashion that they deprive 'the patient of speech, motion and sensibility to pain, while he is still conscious of everything that happens around him; thus realising that night, in the churchyard, and are yet unable to move a hand or a lip for our own deliverance!' Use of the smouldering fruitbodies in Germany to smoke chests used for storage of grain is also reported by Brondegaard (1987).

The North American Indians had a variety of other uses for puffballs, summarised by Burk (1983). These include use as a dusting powder or baby talc (Smith, 1923; 1933), as a rattle by medicine men, as necklaces, prized because of the delicate odor they gave off, and for children's games. The flesh of some species was used as a pin cushion in parts of Denmark (Brondegaard, 1987).

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*Fig 3*  
*Cyathus stratus* – one of several bird's-nest fungi which yield the drug-complex cyathin. (Photo: Gordon Dickson)

*Fig 4*  
*Handkea (Calvatia) utriformis* – an edible puffball, also once used to produce amadou. (Photo: Gordon Dickson)
Finally, the hygroscopic nature of *Astraeus hygrometricus* led to the practical use of this species as a hygrometer according to Rolfé & Rolfé (1925). *Piediluithus tinctorius* is popularly known as 'Dye Ball' due to the abundant yellow and purple dyes which it contains (Stevens & Kidd, 1953). In Europe, and elsewhere, this species is used for dyeing of cotton and wool, and in the Canary Islands and parts of Italy for dyeing silk (Rolfé & Rolfé, 1925).

There are few practical uses to which stinkhorns have been put. However, in China, the boiled liquid from species of *Phallus* and *Dictyophora* is used as a short-term food preservative (Ying et al., 1987). It is also interesting to note that, although they are not luminescent, according to Ramsbottom (1963), stinkhorns as well as *Clathrus ruber* are reported to emit sufficient radiation to affect photographic film even through cardboard!

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