these are allergic or idiosyncratic reactions, because only one or two instances for each species have been recorded. In a few cases, however, more people were affected, a situation suggesting the presence of a toxin that produces a reaction in at least a portion of those who eat it. Some mushrooms that fall into this category have been known for many years and have been termed "partials," a name implying that only some individuals react negatively to these mushrooms, for example, *Armillaria mellea* complex (honey mushrooms), *Verpa bohemica* (false morel), and the *Morchella* group (morels). Other partials have been added to the list in recent years: *Laetiporus sulphureus* (the sulfur shelf), *Pholiota squarrosa*, *Leucoagaricus naucinus*, and *Coprinus comatus*. Whether these reactions are due to a true chemical toxin to which only a portion of the population is susceptible or whether there is some other basis for the sensitivity remains to be determined.

## DANGERS OF RAW FUNGI

Throughout this book, the importance of cooking mushrooms well is emphasized. There is no reason to eat mushrooms raw and a lot of reasons why one should not. Reactions after eating raw mushrooms have been well documented.[7–9] Many heat-labile toxins are present in otherwise perfectly edible mushrooms, including comestibles such as morels (*Morchella* sp.), the honey mushrooms (*Armillaria mellea* complex), and the blewitt (*Lepista nuda*). Certain species tend to be mildly toxic for some individuals even after cooking, for example, the milky caps (*Lactarius*), the chicken-of-the-woods (*Laetiporus sulphureus*), and *Russula* sp. These mushrooms, of course, are more predictably toxic when eaten raw. And in a few, additional problems such as hemolysis may surface. The nature of these thermolabile toxins is not known, although the sesquiterpenes are the suspect in some species.

In 1990 four physicians dining at a San Francisco Italian restaurant developed gastrointestinal distress 30 minutes after eating a dish gastronomically described as "raw lobster mushroom in an oil and vinegar dressing." Not only was the mushroom served raw, but it was even misrepresented, because on closer inspection by a mycologist, it proved to be *Laetiporus sulphureus* (chicken-of-the-woods) and not *Hypomyces lactifluorum* (the lobster mushroom).[10]

The habit of using mushrooms raw in salads should be discouraged. Not only are the store-bought, cultivated *Agaricus bisporus* commonly used raw, but also cookbooks and chefs have promoted the use of uncooked thin slices of the cèpe (*Boletus edulis*), the jelly tongue fungus (*Pseudohydnum gelatinosum*), and the orange peel fungus (*Aleuria aurantica*). Admittedly, an occasional meal of such delicacies will do no harm at all, but it is better not to encourage exceptions. It is more important to get across the message that all mushrooms should be well cooked. The word *well* should be stressed, because the new, young chefs have developed the habit of applying the flame for the briefest of times, barely warming ingredients to release their volatiles and flavors. Although this technique may be fine for herbs, it can lead to problems when mushrooms are in the pan.

## BIOLOGICAL ROLE OF MUSHROOM TOXINS

The biological significance and role of these secondary compounds in the life of mushrooms are virtually unknown. However, it is clear that toxic chemicals are present in many of the large fleshy fungi, reaching clinically significant concentrations in only a small minority of specimens. Amanitins have been detected in the cèpe, the chanterelle, and others, usually in such minute quantities that detection by very sensitive techniques, such as radioimmunoassay, is required. Studies have shown that 1 kg (2.2 pounds) of *Amanita rubescens* (red blusher) contains only 0.1% of the presumed lethal dose for humans.[11] In other words, edible mushrooms in which only trace amounts have been detected are perfectly safe to eat, at least those that contain trace amounts of amanitin.

The taxonomic position of a mushroom is no indication of the toxin it may contain. The amatoxins, for example, are found in various species of four unrelated genera, other representatives of which are perfectly edible. In certain cases, however, most of the species within a given genus contain toxins. The best example of this is the presence of muscarine in the overwhelming majority of *Inocybe* species.

Why toxins are present in certain species is unknown. Only the most anthropocentric person would consider the presence of toxins to be a defensive strategy by the mushroom to avoid human consumption. The role of most of these so-called secondary compounds in the plant and the fungal kingdoms has been grist for the speculation mill. These substances do not appear to be crucial for growth, development, or reproduction. However, they may play important roles in the relationship of the organism to surrounding plants, trees, animals, and insects. Some investigators have suggested that certain compounds have evolved to discourage consumption by herbivores.[12] While plant–herbivore interactions have been well studied, little is known about fungal–herbivore relationships. These compounds almost certainly fulfill important roles