motions arrived at by the comparison of a large number of "snap" pictures. The insect was in each case placed on a white ground within a shallow box covered with glass and illuminated by oblique sunlight. In this way the disposition of the shadows became of great service in determining the positions of the legs.

Attractive Characters in Fungi.

No doubt the characters of the fungi mentioned by Mr. C. R. Straton on p. 9 are attractive, but it does not follow that they are useful. Mr. Straton's letter contains many incorrect statements: the importance of colours and odours to flowering plants cannot be correctly said to be "perfectly understood"; fungi are not "insusceptible of fertilization"; the common mushroom has no "parasitic period," and the first stage of its existence is not "passed in the body of an animal host."

The common mushroom never grows on the droppings of the horse, or upon the droppings of any other animal, and it cannot even be made to grow artificially upon fresh dung. An admixture of earth with decayed dung is required before mushrooms will grow. The mushroom is not a dung-borne fungus at all. It grows in pastures in common with a vast number of other pasture-fungi, and if we allow that the spores of the mushroom must needs first germinate in an animal stomach, it would be but reasonable to assume that the spores of other pasture-fungi would have a similar habit. The mycelium so commonly seen on horse dung is not the mycelium of the mushroom; it belongs to various dung-borne *Coprin*i, and it is certainly not necessary for the spores of these *Coprin*i to pass through a horse's intestinal canal, as they will readily germinate, not only on and in dung and its juices, but on wet blotting-paper, and on almost any other non-corrosive damp and warm material.

Mr. Straton seems to have a remarkable idea of the nature of a "parasite"; because an animal swallows spores, therefore the spores on being swallowed become "parasites." He might as reasonably describe the seeds eaten by graminivorous animals as "parasites," or the seeds of the strawberry and raspberry, when eaten with the pulp by man, as "parasites" in the human system.

As Dr. Cooke, in his interesting letter on p. 57, has not mentioned one special character of certain fungi which has greatly interested me, I may venture to advert to it here. I refer to *gluten*. Many fungi, especially Agarics, are highly glutinous, and if this gluten is not "attractive," it is, I think, useful.

Agaricus radicans is one of our commonest stump-fungi; it has, when young, a perfectly dry pileus. As the fungus reaches maturity, the pileus becomes glutinous. The change reminds one of the change in the condition of the stigma in flowering plants. If sections are made through the pileus of *A. radicans* in different stages of growth, it will be found that as maturity is gradually reached the centre of the pileus softens and swells, and through the now soft mass an enormous number of cystidia protrude themselves. The cystidia exactly resemble the cystidia of the gills. The cystidia open at the apex, and gluten exudes through the open mouths on to the cap of the fungus. If the sticky material from a mature example is microscopically examined, it will be found more or less full of germinating spores, which have been wafted on to the sticky pileus by the wind. The gluten possibly aids germination, if it does not—as I believe it does—cause fertilization.

Agaricus mucidus has a highly glutinous pileus, and it grows in such a fasciculate and closely imbricated manner on beech trunks, that all the spores from the upper examples fall of necessity on to the thick gluten of the examples immediately underneath. If the gluten is microscopically examined, it will be found full of the germinating spores of *A. mucidus*. The uses of the gluten here seem obvious. The simple spores of an Agaric might have but a poor chance of effectually germinating and growing upon a beech trunk, but if the spores had previously germinated and formed a mycelium in a highly glutinous material, they would have a fairly good chance. The sticky pileus would at length be blown from the beech trunk by the wind, and its mucidous character would cause it to stick to the first trunk or branch it might be blown against, and so the gluten and its living mycelium would become attached to a fresh host. *A. mucidus* is peculiar to beech woods.

I could extend these notes to other gluten-bearing fungi, as *A. adiposus*, &c., as well as to Agarics with glutinous stems; but

the two examples above given may serve as a hint to other observers.

How have truffles acquired their subterranean habit? They are always eagerly eaten by pigs, squirrels, rats, and other animals when they grow near the surface, and the deeper placed examples alone survive. Would the constant destruction of tubers near the surface at length bring about a subterranean habit?

WORTHINGTON G. SMITH.

Dunstable.

UNDOUBTEDLY there are numerous glutinous fungi, and the coating of gluten has a useful purpose. Whether Mr. Worthington Smith has quite apprehended the nature of that purpose may be an open question. The majority of the species in the genus *Hygrophorus* are glutinous, and this genus, as a whole, is about the latest in its time of appearance in the autumn. It is very suggestive to observe them apparently unharmed by frost, whilst the Agarics have collapsed, and are in rapid decay. That the glutinous coating is in this instance a protection from frost can scarcely be denied. Dr. Quelet, the French mycologist, has stated that in the Vosges some species of *Hygrophorus* do not appear until the early frosts have commenced, and he has borne testimony to the fact that they flourish in frosty weather without apparent injury. Both the species of Agaric to which Mr. Smith alludes, *Agaricus mucidus* and *Agaricus radicans*, may be found late in the season, apparently indifferent to the frost, which affords a suspicion that the glutinous coating is a protection from frost. *Agaricus carbonarius* is viscid, but much more so as cold increases, and for two consecutive years we have watched it growing uninjured far into January, when no other Agaric could be seen. We do not contend that the "useful purpose" is in all cases a protection from frost, because in some early species we imagine it serves primarily as a protection against evaporation. Presuming that Agarics may contain more than 80 per cent. of water, such a protection would be of service to species growing in exposed situations. If Mr. Smith's suggestion as to *Agaricus mucidus* is accepted, it can only apply to that species, and *Agaricus adiposus*, and one or two others, as the majority of tufted species growing on trunks are not glutinous. Another explanation must be found for the whole *Myxarium* section of *Cortinarius*, for *Gomphidius*, for many of the *Boleti*, and for such Agarics as *Agaricus æruginosus*, *Agaricus semiglobatus*, *Agaricus lentus*, *Agaricus glutinosus*, *Agaricus roridus*, and many others. The idea that gluten "causes fertilization" is a novel one, and may be held as a private opinion, but cannot be accepted generally without evidence much stronger than individual belief; hence, although put forward by so experienced a mycologist as Mr. Worthington Smith, it must not be accepted as an admitted fact, but only as an individual opinion.

M. C. COOKE.

THE RESEARCHES OF DR. R. KENIG ON THE PHYSICAL BASIS OF MUSICAL SOUNDS.¹

II.

SO far we have been dealing with primary beats and beat-tones; but there are also secondary beats and secondary beat-tones, which are produced by the interference of primary beat-tones. An example of a secondary beat is afforded by the following experiment. Recurring to the preceding table of experiments, it may be observed that when the two shrill notes, ut_6 , sol_6 , giving the interval of the fifth, are sounded together, the inferior and superior beat-tones are both present, and of the same pitch. If, now, one of the two forks is lightly loaded with pellets of wax to put it out of adjustment, we shall get beats, not between the primary tones, but between the beat-tones. Suppose we add enough wax to reduce the vibration of sol_6 from 3072 to 3070. Then the positive remainder is 1022, and the negative remainder is 1026; the former being ut_5 flattened two vibrations, the latter the same note sharpened to an equal amount. As a result there will be heard four

¹ By Prof. Silvanus P. Thompson. (Communicated by the author, having been read to the Physical Society of London, May 16, 1890.) Continued from p. 203.