A Fruit Rot of Apples Caused by a Species of *Rhizopus*.

In the course of investigations on the 'codling moth,' the Imperial Entomologist received apples from Quetta which were affected by a soft-rot due to fungal infection. Such samples were sent to the Mycological Section for examination and report throughout the months of June and July. The rotting fruits were soft but firm and in the earlier stages did not show any 'leak'. The skin was "russet" to "verona brown" in colour (Ridgway's) and could be easily peeled away from the underlying tissue. The fruit had a slightly sour but not an unpleasant odour and was easy to cut across, for, the core hardly offered any resistance. The pulp was "zinc orange" and the scales, within which the seeds were enclosed, easily detached themselves from the tissue of the core. On the surface of the fruit no fungal growth was perceptible but the seeds were covered with a weft of mycelium studded with black bodies. In certain cases the seed was absent but the cavity was occupied by a thin mycelial pad. Whenever the skin was removed or the fruit cut open, whitish aerial mycelium appeared on the surface within twenty-four hours.

Microscopic examination of the diseased tissues showed the presence of broad, coarse, aseptate, light brown hyphæ following a tortuous course probably due to their being inter-cellular. These main hyphæ produced narrower lateral branches of variable length which usually penetrated the host cells and sometimes the inter-cellular spaces also. The host cells abutting on the hyphæ were darker brown than those farther away and the hyphæ could therefore be easily traced. There was no "killing in advance" in the green apples; the rotting was closely associated with the hyphæ. The mycelium enveloping the seed was broad, coarse, aseptate more or less hyaline and rhizoids were rare.

Tissue cultures in most isolations yielded pure cultures of a fungus which was identified as a species of *Rhizopus*. The sporangiophores of the fungus formed within the cavity containing the seeds were usually borne on bulbous, brownish swellings or were the terminations of ordinary hyphæ. On the bulbous swellings one to many sporangiophores were produced in the manner figured for *Rhizopus arrhizus* Fischer by Zycha[1] and for *R. nodosus* Namys. by Lendner.[2] These sporangiophores measured usually 160 to 480 μ in length. The sporangia were more or less globose and 80 to 176 μ, mostly 100 to 112 μ, in diameter. The spores were slightly angular, faintly striated, irregular in size and 5 to 7·2 μ in diameter. Hyaline chlamydospores were sometimes noted.

The fungus produced light brownish rhizoids on culture media (though sparsely), and hyaline or faintly pigmented stolons. When sporangiophores were formed on ordinary hyphæ, the sporangia were rather small and developed a hemispherical columella. Bulbous swellings on which the sporangiophores frequently arose on the naturally infected fruit were rather rare in culture media, but when they did appear they developed more frequently in culture tubes than in Petri dishes. Tentative studies indicate that the fungus can grow

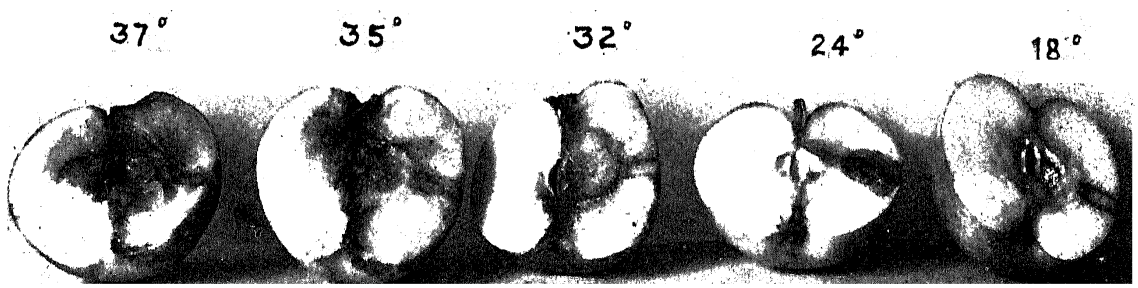

Fig. 1.

Showing the effect of temperature on the rotting of ripe apple fruits after forty-eight hours.

from 10° to 40° C., sporangial formation taking place at any temperature from 15° to 40° C. Best growth of the fungus appeared to be at 37° C. Chlamydospores developed on the stolons and on the ordinary hyphæ.

A majority of the rotten apples that had been received were green or partially mature fruit and artificial infections were therefore made on both the green partially mature, and ripe fruits. Slight wounding was necessary to start infection. Rotting was slow from 15° to 23° C. but between the temperatures of 32° to 38° C., very rapid decay took place (Fig. 1). The 'well' method of infection gave more uniform results. The rot extended within as rapidly as it increased on the surface and examination of artificially infected and completely decayed fruit showed that the fungus had enveloped the seed with a weft of mycelium just as in a naturally infected fruit. Both the ripe and the green fruit were equally susceptible.

The fungus falls within the 'arrhizus group' of Yamamoto[3] and fits *R. arrhizus* of Zycha.[1] It is hoped to correctly establish its identity after a careful comparison with authentic cultures of some of these fungi. *R. nigricans* Ehrenberg has been known to cause apple rots in countries with temperate climates and parasitic potentialities of the species of 'arrhizus group' which grow better at higher temperatures are well known and their parasitism on apples, other fruits and vegetables has also been established by Harter and Weimer.[4]

So far only one other fungus, *Aspergillus niger* Van Tieghem, has been reported to cause rot in apples by Dey[5] but rot due to a species of *Rhizopus* has not been yet reported.

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[2] Lendner, A., *Les Mucorinees de la Suisse.*

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[5] Dey, P. K., *Ind. Jour. Agric. Sci.*, 1933, **3**, 663–673.

An Amphibious Parasite from Lac.

In their reply to the controversy upon the hosts of *Eupelmus tachardiæ*, How. Negi, Glover and Gupta[1] illustrate a "just hatched larva", (Fig. 1 *c*), which hardly shows any hymenopterous characters, much less those specific to *Eupelmus tachardiæ*. With regard to Fig. 1 *d* they confess "details are not fully shown", although the larva is supposed to be full grown. It is very modest of them to say so, for I find not a single character distinguishing it from that of Elasmus or of Microbracon; even the magnification is not indicated. (Fig. 1 *e*) should represent a prepupa and I have not come across the prepupal stage of any chalcid I have studied. On the contrary their figure shows typical pupal characters, so that they are not able to interpret even what they illustrate. In Fig. 1 *e*, the pupa then, and not the prepupa, is partly visible and partly hidden by the

Fig. 1.

Pupa of a female *Eupelmus tachardiæ*, How.