PYGMEPHORUS SPECIES (ACARINA : PYEMOTIDAE) ASSOCIATED WITH CULTIVATED MUSHROOMS

BY

B. GURNEY and N. W. HUSSEY.

(Glasshouse Crops Research Institute, Littlehampton, Sussex).

These tiny mites, widely known in this country as Red Pepper Mites and in America as Pigmy Mites, have excited the curiosity of mushroom growers for many years. They normally appear with dramatic suddenness, swarming on the sporophores, lumps of chalk or other excrescences above the casing surface. Most growers recognize that they do little damage to the mushroom crop but they naturally detract from the appearance of harvested mushrooms. As they are difficult to remove, even by mechanical washing techniques, they constitute a serious problem at soup processing plants. Mushroom pickers find them a considerable annoyance and some cases of allergy have been reported from America. Five species have been recorded from mushroom compost, but during a recent systematic examination of many commercial crops in Britain only two species were found, *Pygmephorus sellnicki* Krczal and *P. mesembrinae* Canestrini (= *americanus* Banks) (figs. 3 and 4). *P. tarsalis* Hirst was identified by Dr. A. M. HUGHES as occurring in enormous numbers at a farm in Kent in 1956 (MORETON, 1956).

In 1960 LOMBARDINI described *Microdispodides fungorum* and *M. buae* from mushroom beds in Italy (BUA, 1964), but there is no doubt from his illustrations that these are synonymous with *P. mesembrinae* and *P. sellnicki* respectively. More recently two distinct species *P. lambi* and *P. allmanni* have been described by KRCZAL (1964 *a*, *b*) from material collected in Australia and New Zealand.

Cultures of *P. mesembrinae* and *P. sellnicki* have been successfully maintained over many generations at this Institute and the life-history of both species appeared to be identical. Growers widely believe that *Pygmephorus* mites appear in composts which have not been properly prepared and in which the olive-green weed mould *Chaetomium* develops. However, while this association appears to be common, neither species will feed on pure cultures of either *Chaetomium* or *Agaricus*, for they soon die out without reproducing. Cultures of *Trichoderma*, on the other hand, support thriving colonies of both species. *P. sellnicki* can also be reared successfully on both *Monilia* sp. & *Humicola* sp.

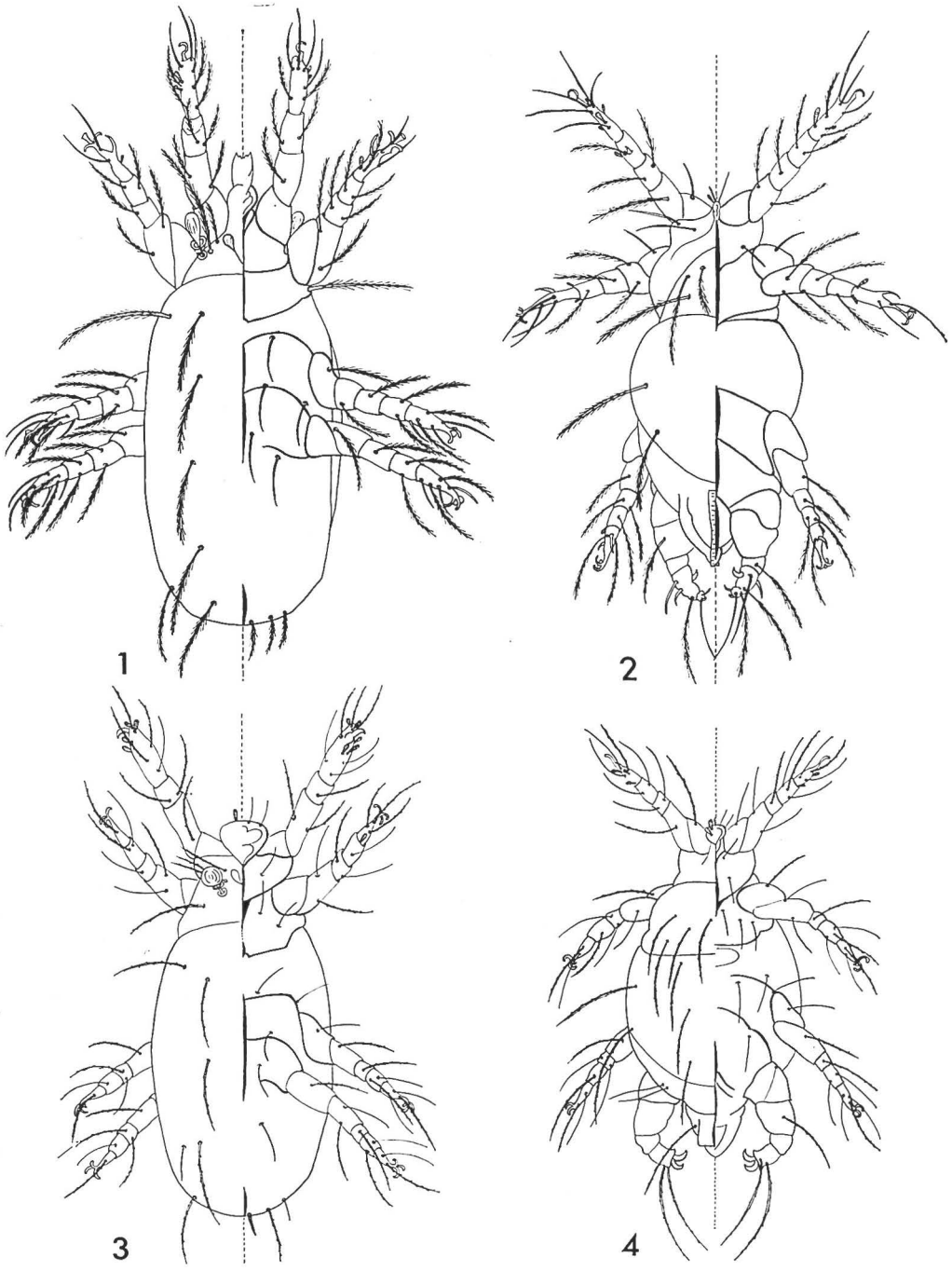

FIG. 1-2. — *Pygmephorus sellnicki* ; 1 — Female. 2 — Male.
FIG. 3-4. — *Pygmephorus mesembrinae* ; 3 — Female. 4 — Male.
For each figure, right side = ventral, left side = dorsal.

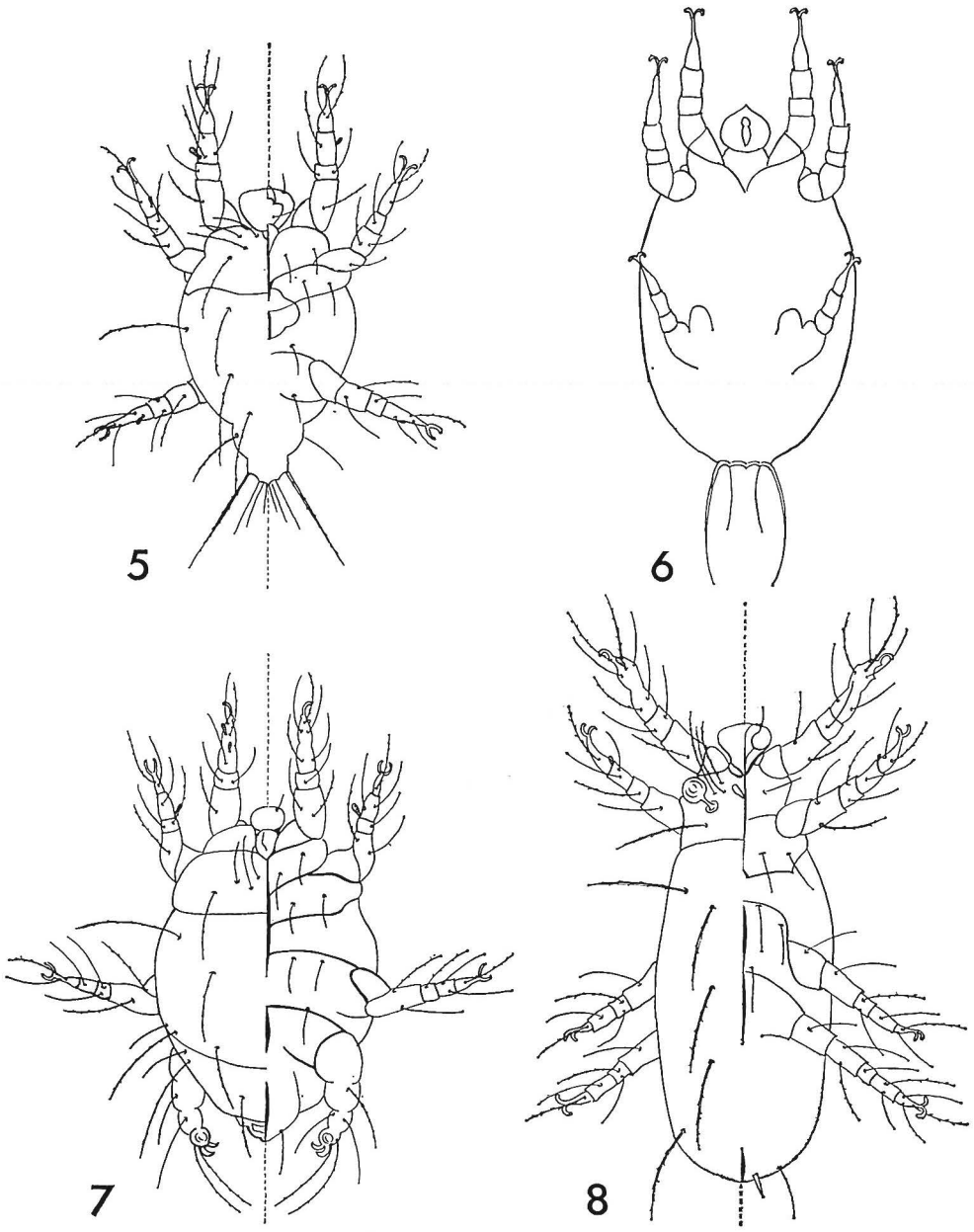

FIG. 5-8. — *Pygmephorus mesembrinae*.

5 — Female larva, 1st instar. 6 — Female larva, 1st instar in resting stage.
7 — Male larva, 1st instar. 8 — Female larva, 2nd instar.

Fig. 5, 7 and 8, right side = ventral, left side = dorsal.

HUSSEY (1964) has reported interesting differences in the development of maximum populations of *P. sellnicki* in different mushroom crops, presumably in response to different patterns of mould development. Observations on experimental crops, within which both *Pygmephorus* species were breeding, showed that only *P. mesembrinae* swarmed on the first mushrooms produced while *P. sellnicki* invariably swarmed on sporophores of the third and later flushes.

Life cycle.

Successful cultures were established by placing single adult females on pure cultures of *Trichoderma* either within bacteriological test-tubes or in Petri-dishes. After about 24 hr. these females began to swell and, within two days, had enlarged

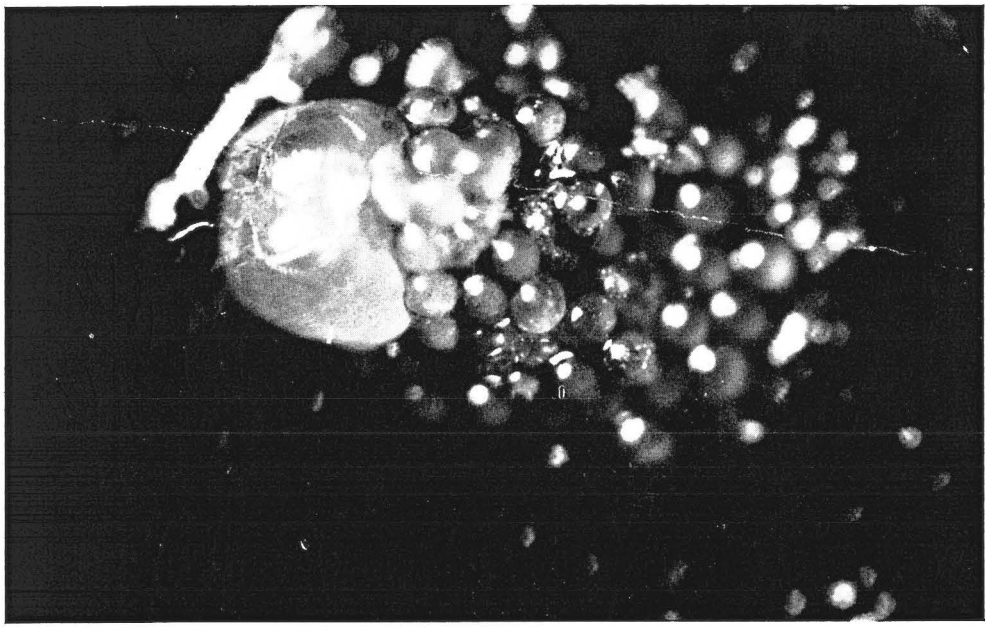

FIG. 9. — *Pygmephorus mesembrinae.* Swollen female producing eggs.

to pearl-like globules about 1 mm in diameter. Oviposition commenced as soon as the females began to swell but when they were still mobile. On the first day between 40 and 50 spherical eggs, 88 μ in diameter, were produced singly and hence scattered at random as the female moved through the mycelium. Subsequently, as the female became immobilised, a mass of eggs was produced which, if moisture was present, spread out like a raft. Oviposition continued for about 5 days, a total of about 160 eggs being produced by each female.

The eggs hatched into active six-legged larvae (fig. 5) within 1 day at 18° C. Most of the earliest eggs, laid while the female was still mobile, produced male offspring (fig. 7). These are recognisable, even as larvae, by the atrophied head and the thickened fourth pair of legs which carry a pair of long parallel setae.

These first instar larvae entered an immobile resting stage, with the legs directed forward (fig. 6), for a further day before the adult male (figs 2 and 4) emerged.. Female larval resting stages produced second instar, eight-legged, larvae (fig. 8) which could be distinguished from the adult female by the less swollen tibiotarsus 1. After feeding for a further day these entered another resting stage, maturing to adult females a day later.

The male larvae remained near the parent egg mass and matured before the bulk of their sisters had reached the adult stage. The only copulation actually observed was between mature males and second instar female larvae. Both species responded similarly to increased temperatures. At 16° C the complete life-cycle (egg to egg) occupied 7 days but at 24° C it was reduced to only 4 days.

KEY TO *Pygmephorus* sp. ON MUSHROOMS
(Based on KRCZAL, 1959).

1. Tibiotarsus 1 with a claw..... 2
— Tibiotarsus 1 without a claw..... *P. lambi*
2. Propodosoma with three pairs of bristles. External caudal seta 1 longer than either the internal caudal or external caudal seta 2..... *P. mesembrinae*
— Propodosoma with two pairs bristles..... 3
3. Empimeron III reaches the line surrounding Coxa III..... *P. sellnicki*
— Empimeron III ends close to external praesternal setae..... 4
4. Sternum II complete between Epemeron II and III..... *P. tarsalis*
— Sternum II only visible for short distance anterior to Epimeron III... *P. allmanni*

Practical Importance.

THOMAS (1942) reported that *P. mesembrinae* could be found in manure heaps as well as mushroom beds and that, after spawning, numbers increased so rapidly that the mycelial growth was inhibited in the upper compost layers. The effect on mycelial growth was said to cause poor, and delayed, sporophore production.

The demonstration that, in pure culture, neither of the common British species will feed on mushroom mycelium suggests that any deleterious effects apparently associated with *Pygmephorus* mites are, in reality, due to unsatisfactory composts. Any compost which is not rapidly colonized by mushroom mycelium encourages the development of weed moulds on which the mites thrive. Composting investigations at GCRI where sugars and ammonium salts were added experimentally to composts have provided striking proof of this. In replicated experiments, *Pygmephorus* mites consistently appeared only where these substances were applied in amounts large enough to influence the microbiological flora of the compost.

Since *Pygmephorus* mites swarm on to the mushrooms and bed surface only when the food supply is depleted by their rapid population increase there is little point in attempting chemical control. Correct preparation of compost will largely prevent the trouble and, even if swarms of mites do develop, they disappear harmlessly within a few days.

Summary.

The life-history of the two most important British species of ' Red Pepper Mites ', *Pygmephorus mesembrinae* Canestrini and *P. sellnicki* Krczal, is described and figured. A key to the five *Pygmephorus* sp. known to be associated with commercial mushroom production is provided.

REFERENCES

Bua (G.), 1964. — Due nüovi acari parassiti delle fungaie. Int. fitopat. **14** : 117-8.

Hussey (N. W.), 1964. — Mites as pests of cultivated mushrooms. Rep. Glasshouse Crops Res. Inst. **1963** : 114-117.

Krczal (H.), 1959. — Systematik und Ökologie der Pyemotiden In Stammer H. J. Beitrage zur Systematik und Ökologie Mitteleuropaischer Acarina. **1** (2) : 385-625.

Krczal (H.), 1964. — *Pygmephorus lambi* eine neue Pyemotidae aus Champignonkulturen. Zool. Angew. **172** : 318-322.

Krczal (H.), 1964. — *Pymephorus allmanni* eine neue Pyemotidae aus Australien Acarologia **6** : 669-71.

Lombardini (G.), 1960. — Acari Nuovi 41. Redia, **45** : 255-61.

Moreton (B. D.), 1956. — The riddle of the Red Pepper Mite. Grower, **46** : 853-5.

Thomas (C. A.), 1942. — Mushroom Insects : their biology and control. Penn. Ag. exp. Stn. Bull. **419** : 43 pp.