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## House fly puparia (*Musca domestica* L.) from a neolithic field in Thayngen-Weier, Switzerland

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In deposits washed out from a permanently tilled neolithic field in Switzerland several puparia of the house fly (*Musca domestica*) were found. In all probability the puparia derived from manure carried unto the field. The entomological evidence substantiated the assumption that field-manuring was applied in Switzerland about 5000 years ago.

### INTRODUCTION

The presence of insect remains, e. g. puparia of Diptera, in archaeological deposits often provides useful and very detailed information on the local environment. In connection with the excavation of an early neolithic village in Thayngen-Weier, Canton Schaffhausen, Switzerland by Professor W. U. GUYAN and Dr. J. TROELS-SMITH a neighbouring contemporary field was found on a terrace near the settlement (TROELS-SMITH, 1981). The prehistoric field is the earliest European field known (2900–2800 BC). In deposits of an adjacent bog material washed out from the field was found, containing seeds and fruits of annual weeds, which showed that the field was not merely cultivated by the slash-and-burn method of agriculture but was tilled permanently (FREDSKILD, 1978; TROELS-SMITH, 1981, 1984). This suggests that field-manuring was applied already in the Neolithic age; according to FENTON (1981) manuring techniques were known by Roman Farmers in 200–100 BC.

The presence of several fly puparia in the material washed out from the field might substantiate the assumption that field-manuring was applied. This paper reports on the entomological evidence of field-manuring in the prehistoric field.

### MATERIALS AND METHODS

In the outwash from the field 45 fly puparia were excavated (TROELS-SMITH, 1984), of which 43 were submitted to the author with a view to identification. The pupae were extremely well-preserved, however in three specimens the anterior and posterior ends were lost. The neolithic puparia were compared with identified present-day specimens from the collections of the Zoological Museum, Copenhagen or from permanent fly cultures of the Danish Pest Infestation Laboratory, Lyngby. In order to facilitate study of details of the spiracular slits and the anal sclerites some puparia were boiled for about 30 minutes in KOH and washed in distilled water.

## RESULTS

The house fly (*Musca domestica* L.) was represented by 37 puparia (Fig. 1). The resemblance between neolithic and present-day house fly puparia was striking, for instance as regards widths of the spiracular plates (D), their distance apart (I), the ratio I/D and details of the spiracular slits and the anal sclerite. In two puparia well-preserved adult house flies were found.

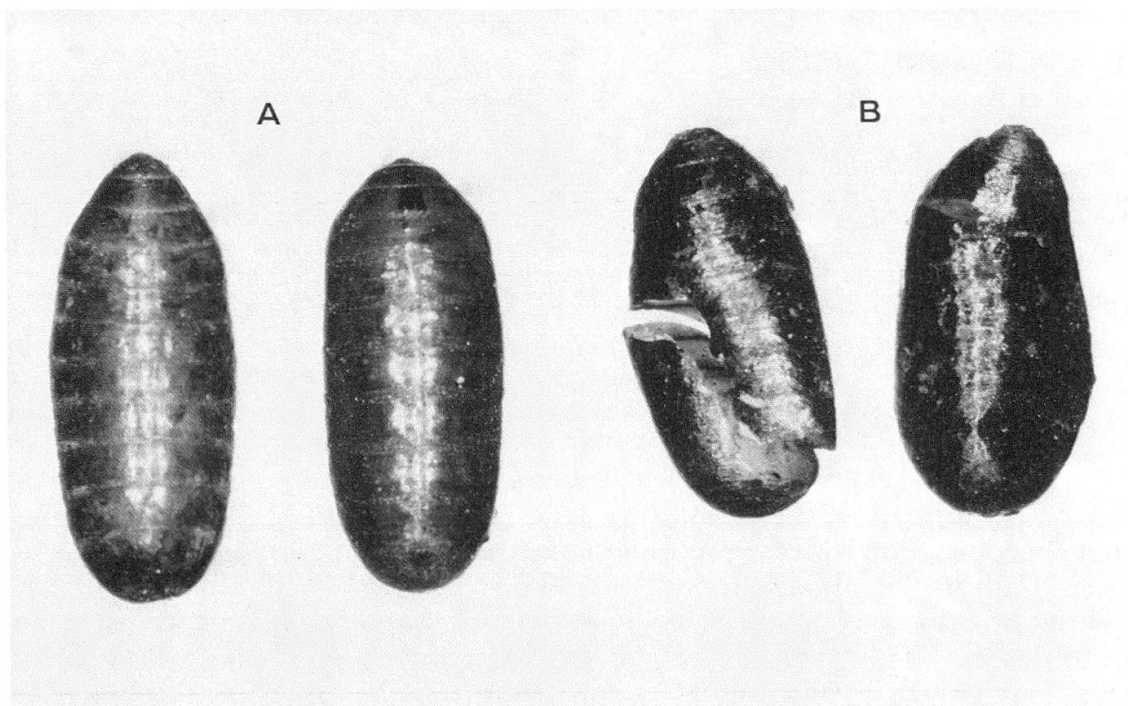


Fig. 1. Puparia of the housefly (*Musca domestica* L.). A. Present-day, B. Neolithic.

Three puparia were assigned to the genus *Muscina* ROB.-DESV., presumably *M. stabulans* FALL. Apparently also the three damaged puparia represented the latter genus.

## DISCUSSION

In North- and Central Europe the house fly is an eusynanthropic, endophilous fly, i. e. a species both trophically and microclimatically closely associated with the biocoenosis of human residence (anthrobiocoenosis), outside which the species is generally unable to produce high density populations (GREGOR & POVOLNÝ, 1958; POVOLNÝ, 1971). In all probability animal husbandry was a prior prerequisite for the establishing of the house fly as a permanent member of the anthrobiocoenosis in North- and Central Europe (THOMSEN, 1938). In the settlement Thayngen-Weier puparia of *M. domestica* were excavated in great number from a byre or pen (GUYAN, 1981; TROELS-SMITH, 1984). This indicates that in 2900–2800 BC the house fly was a symbiotic stable species breeding in dung of livestock accumulated in byres, pens and manure heaps of human settlements. As in our time the thermophilous house fly was certainly a typical eusynanthropic,

endophilous species only attaining high population densities in the favourable bioclimate of the anthrobiocoenosis. In this environment the favourite breeding media of *M. domestica*, viz accumulated, fermenting excreta of ungulates, was abundant and no doubt alternative substrates within or outside the neolithic settlements were quantitatively insignificant in the large-scale propagation of the house fly.

Based on ecological and evolutionary evidence it is improbable that the house fly puparia found in the outwash from the neolithic field reflect a propagation of house flies in decaying, fermenting animal or vegetable matter accidentally occurring in the field. Nor can the puparia originate in cowpats deposited by cattle pasturing in the harvested field, since at least in North- and Central Europe the house fly is not associated with this breeding medium. On the contrary the puparia in all probability derive from dung of livestock accumulated in byres and manure heaps of the settlement. From the village a plankroad was running towards the terraced field (TROELS-SMITH, 1984). Probably manure has been carried out from the settlement along the plankroad unto the field.

*Muscina stabulans* is an eusynanthropic, exophilic fly, i. e. a species associated with the anthrobiocoenosis but not necessarily requiring human habitations (POVOLNÝ, 1971). Although the breeding sites of *M. stabulans* are diverse, the larvae often occur in the same places as those of *M. domestica*, e. g. in manure heaps, preying heavily on fly larvae (THOMSEN, 1938; GREENBERG & POVOLNÝ, 1971; SKIDMORE, 1985). In archaeological deposits excavated in Coppergate, York puparia of *M. domestica* and *Muscina* spp. were found together (PHIPPS, 1983). At least the presence of *M. stabulans* puparia in the outwash from the field does not invalidate the assumption of field-manuring.

Based on the entomological investigations carried out the circumstantial evidence for field-manuring in the Neolithic age in Switzerland and a symbiosis of cattle-breeding and cereal-growing as stated by TROELS-SMITH (1984) is very strong.

#### ACKNOWLEDGEMENTS

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#### ZUSAMMENFASSUNG

In von einem jungsteinzeitlichen, permanenten Acker abgspültem Material wurden viele Puparien der Hausfliege (*Musca domestica*) gefunden. Allem Anschein nach stammen die Puparien aus Stallmist, mit dem der Acker gedüngt worden war. Die entomologischen Belege untermauern die Ansicht, dass Düngen der Felder in der Schweiz schon vor etwa 5000 Jahren angewandt wurde.

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