BEAUFORTIA

SERIES OF MISCELLANEOUS PUBLICATIONS

ZOOLOGICAL MUSEUM - AMSTERDAM

No. 15 1952 MARCH 18

On the Origin of Clothes Moths, Carpet Beetles and Similar Household Pests[1])

by

A. D. J. MEEUSE

(The Hague)

1. Introduction.

It is an established fact that many insects which are now serious pests were once harmless species living on wild plants and other "natural" sources of food. As soon as mankind provided their natural food, or at least an adequate substitute for their natural food, in bulk by cultivating plants, these animals were able to multiply to such an extent that they became a very serious problem. A well-known example is the Colorado Beetle (*Leptinotarsa decemlineata*) which originally lived in North America on a few wild species of *Solanaceæ*, but later attacked the introduced potato plants and thus became the worst insect pest of potato crops, not only in its native country, but also in Europe.

Clothes Moths and Carpet Beetles are also serious pests because they are highly specialised in their nutritional requirements and use the protein keratin as a staple food. Keratin also happens to be the main constituent of wool and hair, the essential fibres for our winter clothing, our blankets, carpets, rugs, upholstered furniture and other textile materials, fur goods, etc. It goes without saying that these articles only became available at the time when prehistoric man started to use animal skins as clothing and to live in more or less permanent settlements. It is most unlikely that the evolution of the Clothes Moths and Carpet Beetles coincided with the early history of human civilisation. Consequently only the alternative remains, viz., that these insects were already living on accumulations of keratinaceous material available in nature and only became pests because man, most conveniently from the point of view of the insects, assembled considerable quantities of wool and hair.

[1]) Received October 9, 1950.

2. The occurrence of keratin-digesting insects in "natural" habitats.

For the answer to the question of the origin of these household pests we should therefore study "natural" supplies of keratinaceous materials. As the keratinophagous insects in question, unlike the parasitic *Mallophaga*, do not attack wool, hair or feathers of l i v i n g Vertebrates we have to search for wastes containing these materials. Such wastes are the remains of dead animals (mammals and birds), the hair used by birds to line their nests, the rubbish piling up in old nest cavities in tree trunks and rocks and, last but not least, the "pellets" produced by owls. These pellets consist of the undigestable parts of the food, chiefly the hair of mice, rats, *Soricidæ* and other small mammals, mixed with feathers, skulls, bones and elytræ of insects, cf. Fig. 1.

Several species of owls have the habit of returning to one and the same place every time they are resting and digesting their food, so that the pellets they bring up often accumulate under trees and in church towers. As often as not the older pellets are inhabited by several kinds of keratinophagous insects. By placing such infested lots in suitable containers which are subsequently stored in a dark and quiet place, sooner or later the adult stages of the species present can be collected from the rearing jars and studied.

The author is interested in all insects attacking wool in connection with his research activities and testing word concerning mothproofing and mothproofing agents. Through the courtesy of A. M. Husson S.C.J. several lots of infested pellets from the Barn Owl, *Tyto alba guttata* (Brehm), were obtained and various species were collected from the rearing jars. Some of these insects have been living in the pellets from the time of collecting (August, 1947, in a church tower at Heer near Maastricht) till now (May 1950) and they must have formed successive generations. Other forms were only present in the beginning, but died out after six to eight months, which may indicate that they prefer living on pellets of a certain stage of deterioration. Considering that in similar cases, such as the gradual digestion of cadaver by a number of insect species which appear and disappear in a fairly regular succession (see Mègnin, 1894, who used the species of insects present as an indication of the age of remains of human corpses in ferensic medicin), several species of insects are limited in their occurrence to a certain degree of decay of their source of food, a similar succession me be precent during the gradual digestion of the pellets, but as far we know this point has never been studied.

3. Insects recorded from pellets in the Netherlands.

The followings species were found in considerable numbers in the pellets and in the subsequent cultures:

Tinea pellionella (Linné) or a closely related case bearing Tineid, still present after more than two years (figg. 2, 3 and 4).

Trichophaga tapetzella (Linné), the Tapestry Moth (fig. 5). Its presence was evident from the numerous pupal exuvia protruding from the pellets.

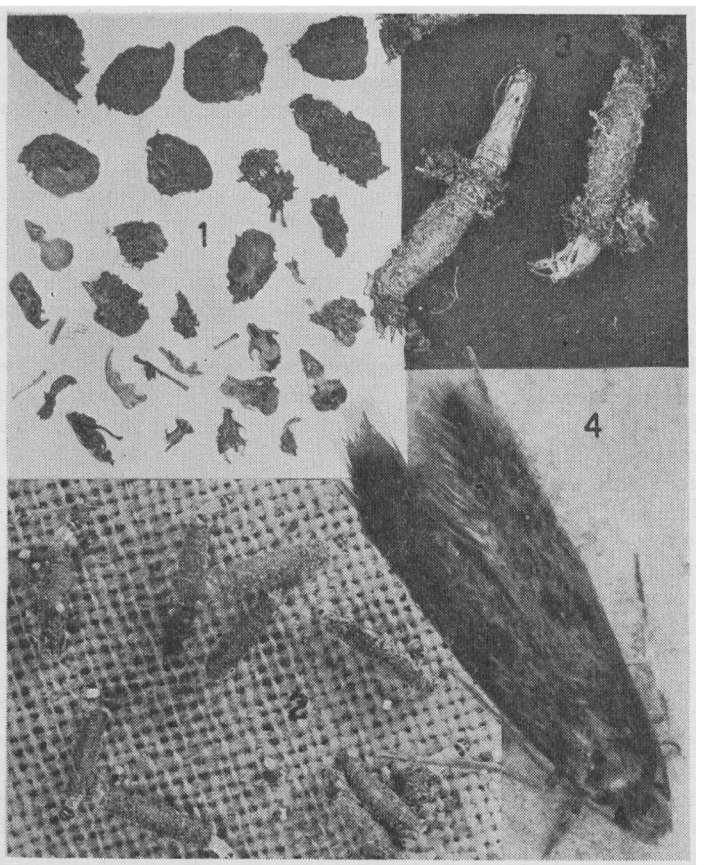

Fig. 1.

Old pellets (from the Barn Wwl), taken from the infested lot mentioned in the text (at left) and some of their contents (at reight), about 1/3 the naural size. They originally consisted of skulls and bones of preys (rodents, shrews, birds etc.) embedded in a mass of hair and feathers belonging to digested preys, but in these old pellets the soft parts have almost completely been digested by keratinovorous insects, leaving the hard, non keratinaceous parts intact.

Fig. 2.

Larvæ of Case-Bearing Tineid, from pellets, photographed on a piece of bunting, x 2. These larvæ have the peculair habit of building a case of piecies chewed of the substratum and spun together. The cases have, therefore, exactly the same colour as the substratum (dark grey in specimens from pellets); this may be a case of protective colouring.

Fig. 3.

Cases of the species represented in Fig. 2, showing the pupal exuvia protuding from the cases after the moths have hatched, x 3 1/3.

Fig. 4.

Tinea pellionella (L.), the Case-Bearing Clothes Moth, adult, x 10. The animal is a dark brown in colour and has a darker spot on the anterior wings.

Fig. 5.

Trichophaga tapetzella (L.), the Tapestry Moth, adult, x 7. This species is of frequent occurrence in old pellets, at least in the Netherlands. The animal is partly creamy-white, partly dark greyish blue. The dark colour soon fades after death, so that museum specimens do not display the contrasting colour pattern any more, (see p. 5).

After one or two generations it died out, probably because the very old pellets did not fulfil their feeding requirements any more.

Attagenus pellio (LINNÉ), the Furrier's Beetle (fig. 6). Although already present in the beginning, it became more numerous after a year and it still is.

The followings species were of rarer occurrence:

Anthrenus spec., Carpet Beetles (probably *A. srophulariæ* (LINNÉ), (figg. 7 and 8). Larvaæ were still present at the time of writing.

Dermestes lardarius (LINNÉ), Larder Beetle. The presence of a few dead mice (evidendy spilt preys) among the pellets may account for the occurrence of this species, but it is possible that the pellets by themselves fulfil the nutritional requirements of *Dermestes* larvæ, for *Dermestes* species have been reporied as pests in woollen goods (e.g. by HERFS, 1932) and the author received *Dermestes frischi* KUGEL. (adults and larvæ) from a firm with the complaint that it occurred in their stores of wool, even in regained wool.

Gnathoncus rotundatus ILL. The author has found the same species or a related Histerid in raw (unscoured) wool. The last two species died out after about three to six months.

Ptinus coarcticollis MULS. *Ptinidæ* are not specifically keratin digesting, but they are fairly omnivorous and occasionally attack woollen goods.

In addition, a Braconid was found, viz. *Apantheles carpatus* (SAY), (fig. 9). This species is known as a parasite of the Common Clothes Moth, *Tineola bisselliella* (HUMM.), but seems to be fairly polyphagous as it was found in some of our cultures of the Case-Bearing Clothes Moth. In the pellets it also parasitizes the case-bearing species, the latter being the only Tineid present when *Apantheles* was still found. Later, HUSSON communicated the occurrence of *Monopis rusticella* (Ct.) in pellets from Kanne near Maastricht, leg. 8-X-1948. Another lot collected in the same neighbourhood in March 1950, and sent to the author also contained this species.

Although the Common Clothes was not found in the pellets it seems plausible that *Tinea bisselliella* (HUMM.) used to have similar habits before it started infesting our houses, because several lots of old pellets kept at our laboratory for rearing purposes became infested with the Common Clothes Moth (evidendly offspring of escapees from our regular cultures of *Tineola*!). According to HERFS (1932) the Common Clothes Moth still occurs in a "wild" state in certain places, especially in old nest cavities (records from Germany).

4. SPECIES PREVIOUSLY RECORDED FROM KERATINACEOUS MATERIALS.

Other species of insects feeding on keratinaceous materials have been reported e.g. by HERFS (1932), AUSTEN and HUGHES (1935), KEMPER (1935), CORBET and TAMS (1934), HINTON (1945), BARRITT and HARTLEY (1948). The following species of moths and beetles have been recorded as pests in keratinaceous fibres and I hope that this enumeration may aid prospective students of these forms. For obvious reasons the list of species cannot be exhaustive, but the species mentioned can be expected in our part of the Old World.

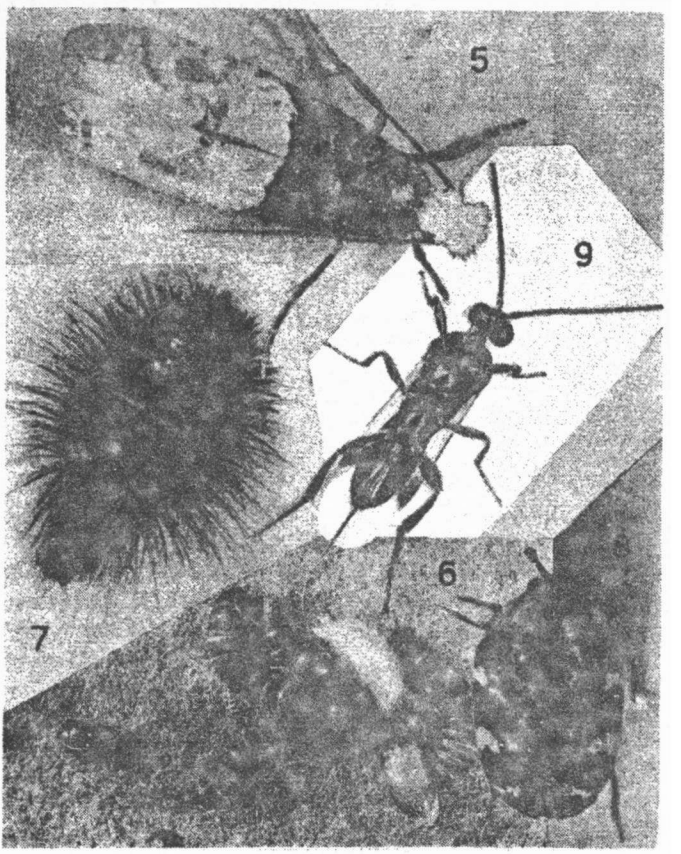

Fig. 6.

Attagenus pellio (L.), the Furrier's Beetle, reared from pellets, photographed on a piece of cloth, x 2. Several larvæ, one pupa and three adult beetles are shown, one of the latter being newly hatched and a pale brown in colour whereas the older ones are pitch-black with a characteristic white spot near the middle on each wing-case. The larvæ are a golden chestnut in colour and have a characteristic caudal brush of long hairs. As a rule they move shock-wise. In houses they attack woollen goods, furs, etc.

Fig. 7 and Fig. 8.

Anthrenus pimpinellæ (L.), Common Carpet Beetle, larva 10, and adult beetle, x 10. The beetles are found on flowers ,especially on *Umbelliferæ*, in spring and in summer, but the larvæ live on keratinaceous materials and those of some related species (locally) known as "Buffalo Bugs" of "Woolly Bears", e.g. those of *A. vorax* Waterh.) are serious household pests in warmer regions (India, parts of U.S.A.). In a "wild" state these larvæ are found in birds' nests, in pellets, etc. The long body hairs of the larva are very characteristic and may serve to detect damage by these insects in woollen goods, even if the animals themselves cannot be found. The adults of most species carpet beetles have a similar colour pattern: white, yellow, brown or sometimes red specks on a dark (black or brown) background, sometimes reserved, i.e. brown specks on a whitish background (*A. vorax*). These colour patterns are brought about by adpressed scales characteristic of the Tribe *Anthrenini* of the *Dermestidæ*.

Fig. 9.

Apanteles carpatus (SAY) a Braconid parasite of the case-bearing Tineid found in pellets, but also of the Common Clothes Moth, *Tineola bisselliella* (HUM.). The animal which is pitch-black is seen from the ventral side, x 10.

Lepidoptera, Tineidæ:

Tineola bisselliella (HUMM.), Common or "Webbing" Clothes Moth
Tinea pellionella (L.), Case-bearing Clothes Moth
Tinea flavescentella HAW.
Tinea lapella HUBN.
Tinea pallescentella STAINT., Large Pale
Trichophaga tapetzella (L.), Tapestry Moth Clothes Moth.
Monopis rusticella (CL.)
Monopis ferruginella (HUBN.).

Lepidoptera, Oecophoridæ:

Hoffmannophila (= *Borkhausenia*) *pseudospretella* (STAINT.), Brown House Moth or False Clothes Moth
Endrosis sarcitrella (L.) = *E. lactella* (DEN. & SCHIFF.), White-Shouldered House Moth

All these moths have been found in Europe, but some of them have also been reported from elsewhere, e.g. from the U.S.A.

Coleoptera, Dermestidæ:

Attagenus piceus (OLIV.), Black Carpet Beetle (cosmopolitan, but seems to do much more damage in North America and in Japan than in Europe; according to HERFS "*Attagenus japonicus* REITT.", which is a synonym of *A. piceus*, is in the latter country a worse pest than *Tineola bisselliella*)
Anthrenus vorax WATERH. (a synonym is *A. fasciatus* HERBST), called the Furniture Carpet Beetle (U.S.A.): its larvæ are known as "Buffalo Moths" (U.S.A.) and as "Woolly Bears" (India). Its original homeland is probably in the Oriental regions, but now it is spread all over the world. It is one of the most voracious species if this group.
Anthrenus museorum (L.), the Museum Beetle (cosmopolitan)
Anthrenus srophulariæ (L.), Common Carpet Beetle (cosmopolitan)
Anthrenus verbasci (L.), Varied Carpet Beetle (cosmopolitan), and several other *Anthrenus* species *Anthrenocerus australis* (HOPE), Australian Carpet Beetle (Australia, New Zealand; in Britain since 1933, in the Netherlands first recorded in 1949, see MEEUSE 1950)
Dermestes spp., Larder Beetles (cosmopolitan).

Some other species have been recorded from "various kinds of waste", "old birds' nests", "rodents nests", etc., and these may, for instance, also occur in pellets. Examples are *Tinea insectella* (FB.) (= *T. misella* ZELL.) and *Trox* spp. ("Rag. Beetle").

In pellets, at least in the Netherlands, *Trichophaga tapetzella* seems to be of frequent occurrence, because WOLDA (1932) mentions the fact that almost invariably the soft parts of old owl pellets are completely destroyed by the larvæ of the Tapestry Moth.

5. A NOTE ON THE PHOTOGRAPHS.

The photographs of some of the species mentioned, which were all taken from l i v i n g specimens, were made by means of a special technique developed by M. VAN ECK, photographer of the Vezelinstituut. The animals prefer living in the dark and strong light disturbs them, so that ordinary photographic lamps cannot be used. Focussing is done in dim light so as to cause as little disturbance as possible and to keep the animals quiet. A flash bulb is lighted by means of a synchronizer on the photographic apparatus when the photo is taken, so that the animals are photographed in flash light, which enables us to work with short exposure times and narrow diafhragms and obtain photos of the animals in their natural attitudes. Details can be found in a paper on the subject by KERPEL and VAN ECK (1948).

6. APPEAL TO THE READER.

Finally, the author avails himself of this opportunity to bring his desire to obtain more data and material to the reader's attention and he invites naturalists in the Netherlands and abroad to submit their evidence to him. Apart from records of incidence of keratinovorous insects in "natural" habitats, consignments of infested pellets are especially welcome. If possible, as many details as can be recorded should be communicated, such as the locality, species of owl, the time of collecting, etc. Interesting findings will be duly reported on.

Almost needless to say, the study of the occurrence of keratindigesting insects has some economic importance, because the "natural" micro-habitats act as reservoirs of these household pests from which new infestations in our homes continually take place.

7. ACKOWLEDGEMENTS.

The author is much indebted to Mr. J. R. H. VAN NOUHUYS, Director of the National Fibre Research Institute (Vezelinstituut T.N.O.), Delft, for permission to use the photos reproduced in this paper, and to Dr. H. C. BLÖTE, Dr C. O. VAN REGTEREN ALTENA and Mr. A. M. HUSSON S.C.J. (all of Rijksmuseum van Natuurlijke Historie, Leiden), for their assistence in naming some of the species and for supplying quantities of infested pellets.

The Hague, Mispelstraat 11, May 1950.

Photomechanical reproduction