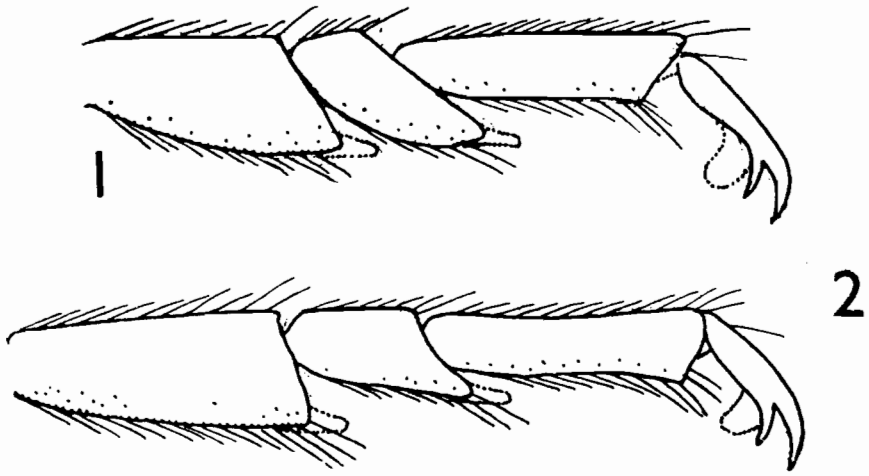
To include this new genus therefore in the key to the Nematine genera in Benson (1958) the second half of couplet 15 should be altered to run on to another couplet 15a to read as follows:

15a(15) Sawsheath in lateral view at least slightly emarginate below the apex, often tumid with an apical thorn, and always shorter than a hind femur (figs. 613-618). 4th hind tarsal segment shorter dorsally than apically. Inner anterior tibial spur often enlarged so that it is more than half as long as basitarsus. Larvae with elongate cerci and feeding in rolled leaves or rolled leaf-edges of *Salix*. 10 British species. Type species: *Nematus leucapsis* Tischbein ..... *PHYLLOCOLPA* **gen. nov.**

— Sawsheath in lateral view evenly rounded below the apex and sometimes longer than hind femur (figs. 619-621). 4th hind tarsal segment at least as long dorsally as apically. Inner anterior tibial spur not more than half as long as basitarsus. Larvae with reduced or obsolescent cerci and feeding in leaf-galls on *Salix*. 12 British species. ..... *PONTANIA* O. Costa



Portion of hind tarsus to show 3rd, 4th, and 5th tarsal segments, and claws in *Phyllocolpa leucapsis* (fig. 1.) and *Pontania viminalis* (fig. 2).

The world species listed in section A of *Pontania* in Benson 1960 (p. 380), belong to this new genus. The British species are:
piliserra (Thomson), *scotaspis* (Förster), *puella* (Thomson), *leucosticta* (Hartig), *excavata* (Marlatt) (=*destricta* MacGillivray), *leucapsis* (Tischbein), *purpureae* (Cameron), *acutiserra* (Lindqvist), *anglica* (Cameron), and *coriacea* (Benson).
The species listed in sections B, C, D and E in the same paper belong to *Pontania* in the restricted sense.

Euura and most other Nematine genera have the longer 4th hind tarsal segment, as in *Pontania*, but the following genera have the segment short as in *Phyllocolpa*: *Cladius, Priophorus, Trichiocampus, Mesoneura, Caulocampus* (*acericaulis* MacGillivray, but not *necopinus* Zhelochovstev), *Craterocerus, Platycampus, Stauronematus* and *Croesus*. As many of the species in these genera oviposit in leaf-petioles or leaf-margins it seems highly propable that the short 4th tarsal segment is in some way correlated with the position taken up by the female in ovipositing. This now needs observing carefully.

REFERENCES

Benson, R. B., 1958, Tenthredinidae Nematinae, in R. ENT. SOC. LOND., *Handbks. Ident. Brit. Ins.*, **6**, Hym, 2c; 1960, Studies in *Pontania* (Hym., Tenthredinidae), *Bull. Brit. Mus. (Nat. Hist.), Entomology*, **8**(9):367-384.

British Museum (Natural History), London, S.W.7.

April 1st, 1960.

BRITISH DIPTERA ASSOCIATED WITH FUNGI. III. FLIES OF ALL FAMILIES REARED FROM ABOUT 150 SPECIES OF FUNGI

BY PROF. P. A. BUXTON, C.M.G., F.R.S.*

INTRODUCTION

In the autumn of 1950 I felt the need to refresh myself by making an excursion into some unfamiliar side of British entomology. I searched for a subject which would require field work and which appeared to be neglected, and decided to investigate the Diptera associated with fungi in Britain.

It was evident that the first requirement was a general survey, wide rather than deep, of flies which might be reared from a wide range of different types of fungi. I have, therefore, made collections of a considerable number of fungi of many different families: I here record almost all Diptera that have been reared from material collected, mainly near Gerrards Cross, Bucks., or Tonbridge, Kent, from the autumn of 1950 to the end of December 1953.

The enquiry has been limited to the 'larger fungi' (*cf.* Ramsbottom, 1951). I have not investigated the microscopic fungi, moulds and rusts; they possess a considerable fauna of Cecidomyidae (*cf.* Anderson, 1936), but there is no evidence that they are fed upon or used by other Diptera. In the period under review I made 447 collections of 154 species of fungi: 196 of the collections (44 per cent.) produced Diptera. The Myxomycetes or Mycetozoa, are excluded. What little is known of them as food organisms of Diptera is given by myself (Buxton, 1954) or Perris (1839).

TABLE 1.—The facts are classified on a mycological basis. The table shows for each group of fungi, the number of species from which collections were made, and the number of collections (and percentages) in which Diptera were found; in certain cases larvae only were seen, and the species of Diptera not identified. Abbreviated from Appendix.

Group of fungi	*Fungi, no. of species*	*Number*	*Collections with larvae*	*% with larvae*
Pyrenomycetes	6	27	7	26
Discomycetes	6	17	9	—
Tremellales	5	34	13	38
Thelephoraceae	11	36	9	25
Clavariaceae	7	10	2	20
Polyporaceae	25	109	50	46
Boletaceae	5	12	6	—
Agaricaceae	82	187	98	52
Gasteromycetes	4	12	2	—
Imperfecti	3	3	0	—
Total	154	447	196	44

Most records of insects reared from fungi relate to Agaricaceae and Polyporaceae and I, therefore, made an attempt to sample other groups, collecting such fungi as *Hypoxylon, Calocera, Dacrymyces* and smaller Agarics, all common, but apparently never examined by entomologists. Having had a fungus identified I made an attempt to collect it repeatedly, feeling that it is more profitable to give much attention to one species of fungus, preferably a common one, than to spread one's efforts more widely. If a fungus produced no Diptera or only a very limited number of species, I made a point of collecting it repeatedly, feeling that negative evidence is important, but must be firmly established. On the other hand I have never been selective in picking out individual fruiting bodies containing larvae. It is not my primary purpose to make a collection of Diptera, but to discover the relation between Diptera and fungi.

*Deceased December 13th, 1955.

The Insects

The present paper records, without selection, almost all the Diptera reared from the fungi listed in the appendix and in Table 1. A small number of Cecidomyidae have not been examined, though some of the material was dealt with by Buxton and Barnes (1953). It has been impossible to secure identifications of the Sciarinae, all of which appear to be referable to *Bradysia;* this is regrettable for many species feed in fungi and inhabit or attack a singularly wide range of these plants: indeed there are certain fungi from which I have reared Sciarines (*Bradysia*), but no other Diptera (Table 3). It cannot be assumed that the larvae of the species reared all feed upon fungus, as many of them are predatory. In a general survey the first thing to determine is which insect is associated with which fungus or, equally important, which fungi are not used by insects of certain families. When those points have become clearer one can more easily study the numerous biological questions which arise: for instance, specificity of fly to fungus, succession of species in the fruiting body as it matures and decays, predatory habits of larvae and identification of early stages.

TABLE 2.—Showing the number of species of flies, by families, reared by myself in 1950-1953 from the fungi listed in the Appendix and in Table 1: also number of other species recorded by other authors as reared from fungi in Britain. Records of species from the Continent of Europe, and from America (even if referred to in the text) are not included: certain families are included (e.g. Psychodidae) because members have been bred from fungi, though not in Britain.

	No. of species reared by myself	*Other British species recorded from fungi in this paper*
Tipulidae	4 (2)	2
Trichoceridae	3	0
Psychodidae	0	0
Chironomidae	2	0
Ceratopogonidae	2	0
Cecidomyidae	2	0
Mycetophilidae	36 (1)	1
Scatopsidae	1 (1)	0
Anisopodidae	1	0
Empididae	0	0
Dolichopodidae	2	1
Scenopinidae	0	0
Phoridae	12	0
Platypezidae	3	0
Syrphidae	11	0
Otitidae	0	0
Dryomyzidae	0	0
Sapromyzidae	0	0
Drosophilidae	7	4
Sepsidae	0	0
Asteidae	1	0
Borboridae	1	0
Helomyzidae	6	0
Muscidae	14 (1)	2
Total	98 (5)	10

An attempt has been made to review what has been published by others, but there my arrangement is not consistent. For instance, it is possible to bring together what has been recorded about Tipulidae or Drosophilidae associated with fungi as the species appear to be few and specialised: a review of that type appears under the family, before my own observations. On the other hand it is impossible to make such a general review for fungicolous Muscidae, as so little is on record. As to the Mycetophilidae, it seems better to give a brief account, limited to the species which I have reared myself.

I have submitted at least one sample of every fungus to Dr. R. W. G. Dennis, or his colleague Mr. D. Reid, mycologists in the Herbarium, Royal Botanic Gardens, Kew. Material of every species of Diptera has been submitted to Dr. F. van Emden, Messrs. R. L. Coe, P. Freeman, or H. Oldroyd, in the British Museum (Nat. Hist.), except in a few instances acknowledged below. Thanks to all these gentlemen, the systematic basis of this paper is sound. Without their continual help, frequently sought, it would have been impossible for me to make any progress at all. Specimens of many of the Diptera have been placed in the British Museum (Nat. Hist.).

TABLE 3.—Showing a selection of the fungi from which few or no Diptera have been reared. All material is from Gerrards Cross. The month quoted is the one in which the material was collected.

Fungus species	*Month of collection*	*Diptera found*	*No. of collections*
		PYRENOMYCETES	
Xylaria hypoxylon	Sept.	Mycetophilid larvae	1
" "	Oct. Dec.	Nil.	3
Xylaria polymorpha	July	*Bradysia* sp.	1
" "	Aug.	*Bradysia* and *Eudactylocladius icterica*	1
" "	June-Nov.	Nil.	7
		TREMELLALES	
Auricularia auricula-judae	Aug.	*Camptodiplosis auriculariae*	1
" "	Aug.	*C. auriculariae* and *Helomyza variegata*	1
" "	Aug. Oct.	*C. auriculariae* and maggots	3
" "	Various	Nil.	6
Auricularia mesenterica	Feb. May	*Bradysia* spp.	2
" "	Various	Nil.	8
Calocera cornea	Oct. Nov.	*Trichonta vernalis*	1
" "	Nov. Dec.	Yellow Mycetophilid larvae	3
" "	Nov.	Nil.	1
Calocera viscosa	Sept.	*Phronia sinuata, Bradysia* and Cecidomyids	1
" "	July-Dec.	Nil.	6
		THELEPHORACEAE	
Stereum hirsutum	Dec.	*Mycomyia marginata*	1
" "	Oct-Dec..	Nil.	5
Stereum purpureum	Dec.	*Mycetophila luctuosa* and *ocellus; Lestremia*	1
" "	Feb.	*Metriocnemius atratulus*	1
" "	Nov.	*Mycomyia marginata*	1
" "	Nov.-Dec.	Nil.	2
Stereum gausapatum	Various	Nil.	4
Corticium laeve	Nov.	*Mycetophila ocellus*	1
" "	Dec. Jan.	Nil.	5
		CLAVARIACEAE	
Clavaria vermicularis	Sept.	*Trichocera hiemalis* (one specimen)	1
Clavaria inaequalis	Oct.	*Tephrochlamys tarsalis* (one specimen)	1
Clavaria spp. (see Appendix)	Various	Nil.	8
		POLYPORACEAE	
Polyporus betulinus	Various	Nil.	6
Polyporus adustus	May	*Mycetophila trinotata, Fannia canicularis, Ula sylvatica* and *Ditomyia fasciata*	1
" "	Nov.	*Mycetophila trinotata*	1
" "	Dec.	Cecidomyidae	1
" "	Nov.-Dec.	Nil.	5

TABLE 3 (*contd.*)

Fungus species	*Month of collection*	*Diptera found*	*No. of collections*
Fomes ulmarius	Feb. May	*Ditomyia fasciata*	2
" "	June	*Ditomyia fasciata* and *Bradysia* sp.	1
" "	June	Cecidomyidae	1
" "	June-Oct.	Nil.	5
Polystictus versicolor	Nov.	*Ditomyia fasciata*	1
" "	May	Pupa, Nematocera	1
" "	June-Dec.	Nil.	7
Trametes confragosa	Nov.	*Sciophila hirta* and Cecidomyidae	1
" "	Sept.	*Sciophila buxtoni*	1
" "	Sept. Nov.	Nil.	2
	AGARICACEAE		
Marasmius oreades	Sept. Oct.	*Rhymosia domestica*	2
" "	Oct.	Mycetophilid larvae	1
" "	Aug.-Oct.	Nil.	4
Mycena flavo-alba	Dec.	Single larvae Mycetophilid	1
" "	Oct.-Nov.	Nil.	4
Omphalia fibula swartzii	Sept.	Muscid larva	1
" " "	Oct.-Dec.	Nil.	3
Galerina graminea	Oct. Nov.	Nil.	3
Galerina clavata	Nov.-Dec.	Mycetophilid larvae	2
" "	Oct.-Dec.	Nil.	2
Psathyrella pygmaea (*consimilis*)	June-Aug.	*Drosophila phalerata*	1
" " "	July	Mycetophilid larvae	1
" " "	June-Aug.	Nil.	3
Schizophyllum commune	Dec. Jan.	Nil.	3
'Ozonium' of *Coprinus*	May	*Helomyza variegata* (several)	1
" " "	June	*Limosina* sp.	1
" " "	Various	Nil.	15
	GASTEROMYCETES		
Lycoperdon pyriforme	Aug.	*Helomyza bicolor* *Tephrochlamys tarsalis* *Platypeza modesta* and *fasciata*	1
" "	Sept.-Nov.	Nil.	7

METHODS

In the field, material of one fungus species (referred to as one 'collection') is placed immediately in a closed metal box or a polythene bag, so as to avoid the possibility of contamination.

The samples of fungus are placed in wide-mouthed glass vessels of appropriate size on a layer of slightly moist sawdust. Experience shows how much sawdust will be necessary; during decomposition some of the soft *Boletus, Russula,* etc., produce much water. But it is essential to moisten the sawdust at the beginning because some larvae soon require a moist environment in which to pupate. The mouth of the container is closed with muslin and adhesive plaster, or with a rubber stopper pierced by a large hole closed with fine wire gauze. Stoppers with a diameter of one inch and 3½ inch are obtainable from Messrs. Gallenkamp.

This breeding method has the advantage of simplicity and certainly produces a considerable variety of flies. But the fungi are under unnatural conditions, the fruiting body having been cut off from the mycelium. This is likely to be of particular importance with rapidly growing organisms such as most Agarics, or the softer species of *Polyporus*. With those plants the failure of nourishment coming from the mycelium may quickly produce conditions unsuitable for the larvae of certain Diptera. For instance, if one puts the rapidly growing fruiting body of *Polyporus squamosus* in a breeding jar, very large numbers of Mycetophilid larvae will come out in 24-36

hours, nearly all of which will starve and die. One cannot be satisfied that the few individuals which came to maturity were of the same species as the majority of larvae which died of starvation. The method may lead one to think that a certain insect is common, whereas its larva is somewhat resistant to starvation. Other species may be common, but seldom reared.

Each 'collection' is given a serial number. If a number of Diptera emerge they will all bear that number.

Reference is made below to *Muscina assimilis* of which the larva is predatory. In the experience of Keilin (1917) this insect will lay its eggs in breeding jars or deposit them in such a way that the small larva can force an entrance. This has not happened in my experience, indeed I have only bred the insect on one occasion.

TABLE 4.—Showing the groups of fungi from which certain flies have been reared. The flies all exhibit a wide choice among the fungi.

Insect	Pyrenomycetes	Discomycetes	Tremellales	Thelephoraceae	Clavariaceae	Polyporaceae	Boletaceae	Agaricaceae	Gasteromycetes	Imperfecti
Limonia bifasciata						+	+	+	+	
Dicranomyia decem-notata						+				
Ula sylvatica			+			+		+		
Culicoides scoticus						+	+	+		
Mycomyia marginata			+	+		+				
Sciophila lutea	+			+		+		+		
Sciophila hirta		+	+			+		+		
Docosia gilvipes		+	+			+		+		
Mycetophila lineola					+	+		+		
Mycetophila ocellus	+			+	+	+		+		
Mycetophila luctuosa	+			+				+		
Anisopus cinctus		+						+		
Drosophila phalerata						+	+	+		
Drosophila transversa		+						+		
Helomyza variegata		+	+			+	+	+		
Helomyza bicolor	+						+	+	+	
Tephrochlamys tarsalis					+	+		+	+	
Phaonia variegata						+	+	+		

How long should one keep a culture jar in order to be reasonably sure that all Diptera have emerged? The question is of practical importance because it is burdensome to maintain an unnecessary number of jars and observe them at frequent intervals. It is evident that what one collects in the autumn must be kept until the early part of the next summer as a minimum, as may be shown by three examples. A collection of *Amanita muscaria* was made on October 20th. In early December several *Exechia spinuligera* emerged, followed at the end of December and in early January by a number of *Docosia gilvipes*. No other flies emerged until May when I reared several *Helomyza bicolor*. Or again, from *Boletus* collected in October *Cheilosia* emerged from May to early August. To give another example, I collected *Auricularia auricula-judae* in November, 1951, and sent it to H. F. Barnes, who reared *Camptodiplosis auriculariae* from May 18th to June 21st, and a single female on August 8th, 1952. He kept the material a further twelve months, but no more specimens emerged.

But it occasionally happens that the early stages of Diptera remain for a longer period in one's breeding jars. For instance, a collection of *Armillaria mellea* was made on October 27th. Before the end of the year adult *Ula sylvatica* emerged, and a number of Mycetophilid larvae came out and died. In March I bred also *Helomyza bicolor* and *Tephrochlamys tarsalis*, and

observed spiny Muscid larvae in the material. These were still present as resting larvae in September, that is to say eleven months after the date of collection. To quote another example, a collection of *Russula ochroleuca* made in October, still contained small living puparia of a Muscid 14 months later. Unfortunately both jars were neglected and nothing further emerged.

The writings of other authors illustrate the same point. For instance Edwards (1925) collected larvae of *Platyura fasciata* feeding on moulds in the early autumn. These remained as half-grown larvae through the winter, pupating in June and becoming adult in July. The same author reared *Amiota alboguttata* in July, 1936, from *Daldinia concentrica* collected the previous August.

My custom has been to keep what is collected in the autumn until the following midsummer and that is certainly necessary. As to fungi collected in the summer, flies generally emerge soon, and I throw that material away in the late autumn. In acting in this way it seems that living pupae or even larvae are occasionally rejected: this procedure does not give information on all the species of Diptera that may have been present in the fungus. I have made a practice of recording the date on which the material was thrown away: that information may prove to be valuable when we have a more complete knowledge.

In recording my results the notation '8/1' means that eight collections of a certain fungus were made, and that a certain species of insect emerged from one of them. '8/1, several flies' or '8/1, one only' are self-explanatory. Adopting that convention, it is easy to indicate that a single specimen has been reared from one collection. Such records cannot rightly be omitted, neither can one accept them, for they might be due to a single larva, wandering about before pupation.

FUTURE DEVELOPMENTS

Turning to the future, we require to develop methods of trapping larvae as they emigrate full-fed from the undisturbed fungus; we must do this without separating the fruiting body from its mycelium in soil or tree trunk. I have made a few attempts, surrounding the base of a toadstool with a cuff of plastic sheet or waxed paper and packing the space with moist sawdust. The sawdust with larvae in it may be removed daily with a spoon and put in a breeding jar. This method could be developed so as to reveal the succession of different species emerging from the food. The fungus requires frequent attention, and must be close to one's home, and protected from birds, cows, boys, etc. Developing this method one could also obtain single larvae which might yield individual identified adults. One would then have critically identified cast skins of early stages, which is certainly a requisite. Most of the work published, for instance on the larvae of Mycetophilidae, is based on a general association: that is to say the author has preserved and studied larvae which he identifies by adults bred from the same material. This may be safe in certain cases, *e.g.* with species of *Bolitophila* which generally occur in pure culture. But experience with mosquitoes, the early stages of which have been studied so intensively, shows that it is highly desirable to have individual larval and pupal skins associated with their own reared adult.

There is certainly a need for other methods of isolating single full-fed larvae, and when this can be done a number of enquiries can be pursued. I have had some success by offering small tufts of damp moss or fragments of cloth to Mycetophilid larvae emerging from a fungus in a breeding jar. Some of the larvae will make their cocoons in the moss or fabric. Yet another way of obtaining cocoons or pupae is to put the fungus in a piece of muslin or calico and bury the whole in moist sawdust, which will absorb excess water as the fungus decomposes. At a later date one can recover pupae or cocoons from the inner side of the muslin. This is simpler than

hunting for them through a mass of moist sawdust and rotten fungus. Cocoons of Mycetophilids are very delicate, and there is a high mortality among those which are handled.

As to the future, there are many Mycetophilidae, including common species, which have never been reared: the same applies to Diptera of many other families. If we are to find their food plants we should perhaps give less attention to Agarics and Polypores, which have been rather extensively studied by Edwards and by myself, and more to the Discomycetes, Pyrenomycetes and Gasteromycetes, and other groups too: it must, however, be admitted that these groups have not yet yielded much. There is also the possibility that some of these Diptera feed on groups of plants hardly yet explored, for instance on lichens (most suitable for a fungivore), or on mosses and liverworts (see Cheetham, 1920, who reared the Mycetophilid *Boletina inermis* from one of the latter). The subterranean fungi, investigated as food plants of Diptera by Dufour (1839, 1853) and by Laboulbène (1864) have been neglected for nearly a century: these fungi have been recently monographed and discussed by Hawker (1954, 1955) and invite attention. Further, it is possible that many Mycetophilid larvae feed on mycelia of a restricted range of fungi, in soil, or in decomposing vegetable matter. One might also refer to my own encouraging commencement of work on Diptera feeding on Myxomycetes or Mycetozoa (Buxton 1954): it was shown that the common *Mycetophila vittipes* and two species of *Platurocypta* breed on particular species of Myxomycetes, but not on other organisms, so it appears. Until recently I had supposed that no previous author had recorded Myxomycetes as food-organisms of Diptera: Perris (1839) has priority by more than a century, having described a Mycetophilid from *Lycogala epidendrum* (*miniata*).

Our understanding of the biology of any insect is greatly increased if it can be reared continuously in some type of container. Once that can be done the insect becomes available for experimental study and there can be no question of the identity of the early stages. I have not been able to give much attention to this important matter, but have made some attempts to rear Diptera in 'reconstituted fungi'; that is to say, fungi of certain species are taken, exposed to about 50° C. for several hours to ensure that they contain no living insects and then dried. When required one puts the fungus in water for 24 hours and then in a breeding jar with moist sawdust. It is an easy matter to rear *Trichocera hiemalis* and species of *Sciara* in this way, indeed the *Sciara* frequently maintain themselves for a number of successive generations in decomposed fungus in a breeding jar. But there is little value in maintaining a culture of either of these insects for *Trichocera* is easy to culture, and by simpler methods: as to the *Sciara*, one would find them of more interest if it were possible to identify them. On the other hand I have repeatedly failed to obtain early stages of Mycetophilidae by offering reconstituted fungi, though the adults will sometimes live for a long time in a breeding jar. I have, for instance, had *Rhymosia fenestralis* living for some 6 weeks in a jar in February and March and have seen the adults running at dusk over the reconstituted fungi, agitating their wings and probing the fungus with their abdomens, though I was never able to find that they laid eggs. The small Tipulid *Ula sylvatica* copulates readily in a breeding jar, but I have never reared early stages. I have also failed several times with *Forcipomyia ciliata* in spite of offering the adults syrup and various crushed insects and woodlice on which it was hoped they might feed.

THE FUNGI

Most entomologists have little knowledge of fungi, and one could hardly be excused for failing to give a general introduction to these plants. Few entomologists realise the very large number of British species which may be included in the unscientific term 'larger fungi'. The majority of these

are Basidiomycetes of which there are some 2,700 British species: but other groups of fungi also include some large forms, so that the total number of plants with which one might concern oneself is very great, even if the microscopic forms are excluded.

It is often said that the fungi are difficult to identify. This is partly because, in many, the naked-eye characters such as colour, shape and size are extremely variable; also because the mature organisms, and this applies particularly to the Agaricaceae, are soft and apt to decompose rapidly. There is moreover no effective way of preserving them, so that much of the material on which the systematic mycologist works consists of water-colour sketches or notes made from fresh material: the material which he receives is often decomposed. Microscopic characters are helpful, in some groups of fungi, where there are simple precise differences between species in such matters as the size and shape and other characters of spores. But there are not, generally speaking, a great number of different microscopic characters, and there are large genera among the Agaricaceae within which the spore characters are not very helpful.

There has been a tendency for the early authors to use the naked-eye characters and later workers the microscopic ones. This has resulted not only in changes in nomenclature, but in completely fresh systems of classification. Particularly in the Agarics, the genera which may be defined under the two systems are not consistent with one another. Entomologists, indeed, are familiar with changes in synonymy and the difficulties that result from them in their own science. They will readily understand that the mycologist is confronted with still greater difficulties.

Some of these difficulties and changes in synonymy concern us directly. Several early entomological authors refer to fungus growing on the trunks of trees as *'Boletus'*. No species of *Boletus* in the modern sense of the word has that habit; but *Boletus* was used until the early part of the nineteenth century for fungi with pores beneath, many of which would now be placed in the Polyporaceae. By 1801 Persoon in his 'Synopsis' recognised 5 sections under *Boletus* of which the first, the *Suilli,* represents *Boletus* in a more modern sense. Fries in 1821 was the first botanist to fix *Boletus* as a generic name in the modern sense, but not all botanists followed him immediately: it may be supposed that the entomologists were not influenced by his work for some time. Among entomologists who have used *Boletus* in the older sense is Dufour: for instance in 1839 he described the larvae and cocoons of the Mycetophilid *Ceroplatus dispar* on *'Boletus ungulatus'* growing on a dead oak stump. In 1842 the same author dealing with the life history of *Sciophila striata* described the larvae living in a mucous trail on *'Boletus suaveolens* L.' growing on an old limb of black poplar and pupating in the fungus. Dr. R. W. G. Dennis is satisfied that *'Boletus ungulatus'* refers to the plant now known as *Fomes fomentarius* L. (which grows on oak in France though not in Britain) and *'B. suavaeolens'* as *Trametes suaveolens* (L.) Fr. As late as 1849 the entomolgist Perris was still using *Boletus* in the old sense. He described the larva of *Sciophila unimaculata* Macq. from *'Boletus versicolor', i.e. Polystictus versicolor* L. (Polyporaceae).

The entomologist, wishing to study insects frequenting fungi, should realise that it is not only difficult but impossible for him to learn to identify all the species, even of some familiar group such as the Agarics or Polypores. He must either secure the frequent help of a mycologist, or turn to some other field of study. The entomologist will, however, come to rely on his own identifications as he gains experience and comes to realise where he may do so. As a beginner he will derive a great deal of help from the book by Wakefield & Dennis; these authors have 'attempted to produce

common or striking British Basidiomycetes, that is, of mushrooms and toadstools, bracket fungi, coral fungi, puff-balls and their allies'. As to those larger fungi which are not Basidiomycetes, the beginner will be helped by the drawings and text of Ramsbottom (1951). The Foray Committee's 'Guide' (1952) is a selected bibliography of British fungi, with brief notes on the scope of each item.

Most of us, when we think of fungi, have in mind a toadstool growing on the ground, or a shelf fungus coming out of a dead log. It is not always realised that these objects, which we may call fruiting bodies or sporophores, are only a specialised part of the plant, developed to give rise to spores. In many fungi, for instance the Agarics, those fruiting bodies are short lived and decompose rapidly: most of them are only found at certain seasons, generally very brief, and in many species the fruiting bodies are not developed in unfavourable years. The long-lived, generally perennial part of the fungus is the mycelium, which is spread through the soil, or decomposing vegetable matter, or rotten wood, in the form of minute threads. There is no way of seeing it in bulk, but it is presumably much larger than the fruiting bodies even when they are fully developed. This mycelium seldom has characters; either naked eye or microscopic, by which it may be identified, even approximately. In certain fungi there are other important stages in addition to the fruiting body and the mycelium. For instance, in certain species of *Coprinus* a large mass of sterile felted growth known as ozonium may be produced, generally on the surface of logs, occasionally spreading over brickwork and so forth.

Nearly all existing breeding records of Diptera (and the same is true of Coleoptera and Lepidoptera) are from fruiting bodies; but a little information exists as to larvae of Diptera feeding on mycelium. It is not easy to see how we could increase our information on that subject by methods applied in the field. In the laboratory it is possible to culture mycelium of many fungi: this could be developed by an entomologist who might attempt to grow some insects on living mycelium *in vitro*.

In the present paper, the appendix gives a list of all the species of fungus which have been studied, with authors' names, cited in accordance with the International Code of Botanical Nomenclature. For that I am particularly indebted to Dr. Dennis.

SYSTEMATIC LIST OF DIPTERA REARED

TIPULIDAE

The number of Tipulids with fungicolous larvae is not great, and the species referred to below are the only British ones known to have this habit. All, with the exception of *Tipula pagana*, the status of which as a fungus eater is not established, belong to the Limoniinae.

Tipula pagana M.—A clump of *Psathyrella disseminata* was lifted (August 30th, Gerrards Cross) with a considerable quantity of earth, and transferred to a large jar, the intention being to maintain the fungi in good health. Two *T. pagana* emerged six weeks later. There is no evidence that the larva is particularly associated with the fungus.

Limonia (Metalimnobia) bifasciata Schr.—There are several indefinite references to the relation of *L. bifasciata* to fungi (Cuthbertson, 1926; Edwards, 1938). In France it has been reared from *Lactarius azonites* and *Collybia grammocephala* (Riel, 1920). In my experience *L. bifasciata* is common, large numbers frequently emerging about a month after collection in summer. From material collected November 16th a single adult emerged the following July. Bred from AGARICACEAE, *Pleurotus cornucopiae* (11/2), *Lactarius piperatus, Russula luteotacta* and *ochroleuca, Amanita muscaria;* BOLETACEAE, *Boletus versipellis;* POLYPORACEAE, *Polyporus fissilis,* and *squamosus* (11/2); GASTEROMYCETES, *Scleroderma cepa* (one). From Gerrards Cross and Tonbridge.

L. bifasciata is closely related to *L. triocellata* O.S. which Alexander (1915, 1920) has reared in America from *Armillaria* sp., *Clitocybe* sp., *Boletus felleus* and *Hypomyces lactifluorum*. Malloch (1917) found larvae of *L. triocellata* feeding in an Agaric, at Urbana, Illinois, in September. The larva formed a compact glutinous tube in the fungus, and pupation occurred in the tube. The larva and pupa are figured. Alexander has reared

L. cinctipes Say (not British) from *Fomes;* Weiss and West (1920) reared it from *Polyporus dichrous* Fr. in New Jersey, U.S.A.

L. (M.) quadrimaculata L.—Coe (1941) records larvae in *Polyporus schweinitzi* in Epping Forest, Essex, in November, the adults emerging on January 9th: there is a pupal skin with these data in the British Museum (coll. Donisthorpe).

L. (M.) quadrinotata M.—Hinton found a larva in the Agaric *Amanita* sp., Forest of Dean, Glos., August: it fed on larvae and pupae of Mycetophilidae. I reared one in 1954 from the 'fairy club', *Clavaria cinerea* (i.e. from a genus from which Diptera are seldom reared); from Gerrards Cross.

L. nubeculosa M.—From *Clitocybe nebularis* collected in November in Gerrards Cross, one emerged in May, 1955; from *Collybia velutipes* collected in December at Wendover, Bucks., one emerged in April, 1955. It is difficult to interpret these specimens, reared from Agarics, having regard to the large number of collections of those fungi which have been made. The fly is common and widely distributed. If its normal food plant is a fungus, it may be some Agaric not yet investigated.

Dicranomyia decem-maculata L.—Alexander (1920) quotes European records of this insect bred from *Daedalia* and similar fungi (presumably Polyporaceae). The first British record (Verrall, 1912) was based on material bred from a fungus on a decaying beech, at Tarrington: reference is made to its having been bred from *Daedalia* in Germany. Hinton found larvae in large numbers on a log infested with *Polystictus versicolor*. He thought that the larvae fed on the fungus, but was not convinced on that point. This insect is less frequent than other fungicolous Tipulids and is confined to POLYPORACEAE. Material of *Trametes gibbosa* collected in January produced adults from May until September. There was no evidence that a generation was produced in captivity, and I thought that all the specimens were members of the original brood. Their delayed and irregular emergence might be due to unfavourable conditions. An attempt to breed a generation is reconstituted *T. gibbosa* failed. Bred from *Trametes gibbosa* (5/2, many specimens), *Poria mucida*: also from *Phlebia merismoides*, from material collected in 1954. The record from *Poria*, based on a single specimen, requires confirmation. As the larva evidently finds what it needs inside the thick tough sporophore of *Trametes*, it seems unlikely that it could also feed on *Poria* which makes a layer perhaps a millimetre thick on dead boughs. The fly, which undoubtedly emerged from *Poria*, may have been from a wandering full-fed larva. From Gerrards Cross.

Ula sylvatica M.—Alexander (1915, 1920) quotes earlier authors, and refers to Perris's (1849) record of this species bred from *Hydnum erinaceum* Bull. on trunk of living oak; the larvae were gregarious in galleries in the fungus. Alexander also records that the pupa is in the ground, coming to the surface before the adult emerges. *U. sylvatica (macroptera)* was reared by Riel (1920) from *Russula adusta* and *Tricholoma inamoenum*. Coe (1941) adds *Pholiota spectabilis*, from New Forest, Hants: Audcent (1949) adds *Hypholoma fasciculare* and *Tricholoma album*. Hinton has recently reared the insect in numbers from *Auricularia mesenterica*, and observed the larvae feeding on the fungus.

This is a common fungus fly, large numbers of adults frequently emerging from soft fungi, especially if collected in the autumn. Material collected October 27th (containing larvae, but not pupae) produced adults from December 4th onwards. Material collected in January produced adults for more than two months from April 28th, and material collected in May produced adults after six weeks. In a breeding jar in which fungus is decomposing, larvae may be found in the moist sawdust below the fungus. They move about in rough firm galleries, and the pupae occur in the galleries, the sawdust adhering firmly to them. Adults copulate readily in a jar, even in a 1 lb. jam pot. On several occasions a number have been placed with 'reconstituted' fungi, but no second generation was obtained.

Bred from AGARICACEAE, *Pleurotus cornucopiae, Russula nigricans* (see also Parmenter (1950) for this fungus), and *ochroleuca, Tricholoma rutilans, Laccaria laccata, Amanita muscaria, Armillaria mellea;* POLYPORACEAE, *Polyporus squamosus* (many times), *fissilis, giganteus* and *adustus, Daedalia biennis, Trametes gibbosa*. From Gerrards Cross and Tonbridge.

Scleroprocta sororcula Zett.—Hinton has found the larva, on several occasions in the spring, in galleries in *Polyporus betulinus*, generally in fungi which had fallen from the birch tree and were rotting on the ground. The larvae made a portable case and fed on the fungus. I failed to breed any Diptera from seven samples of *P. betulinus* (though one Nematocerous larva was seen once) and also failed to find larvae or their workings in numerous sliced sporophores, some young, others old and crumbling. Failand, Somerset (H. E. Hinton).

TRICHOCERIDAE

Trichocera rufescens Edw.—Once from *Hypholoma sublateritium*, from Tonbridge.

T. saltator Harr.—Once from *Entoloma rhodopolium*, from Gerrards Cross.

T. hiemalis Deg.—From POLYPORACEAE, *Polyporus giganteus*; AGARICACEAE, *Pleurotus ostreatus, Entoloma rhodopolium, Russula* sp., *Amanita phalloides, A. muscaria;* BOLETACEAE, *Boletus versipellis*; CLAVARIACEAE, *Clavaria vermicularis* (a single *T. hiemalis*, on one occasion only). Though I have had several collections of some

though when present the larva is often numerous. One has an impression that fungi do not make a large contribution to the total population of this abundant insect. From Gerrards Cross, Bucks., and Windsor Great Park, Berks.

T. annulata Mg.—Reared by Dufour (1840) from rotten fungi, and by Falcoz (1921) from *Polyporus frondosus*.

T. regelationis L.— Reared from rotten fungi (Dufour, 1840).

PSYCHODIDAE

One might expect to breed Psychodids from deliquescent, half decayed fungi of various types. Reil (1920) working in France reared specimens referred to *Psychoda phalaenoides* L. from *Russula cyanoxantha, Tricholoma inamoenum* and *Amanita phalloides* (the last noted as 'avancé'). *Psychoda pacifica* Kin. is recorded as reared from *Coprinus* sp. in California (Kessel and Kessel, 1939). Satchell (1947*a* and *b*) examined decaying vegetable material for larvae of *Psychoda*, but does not mention fungi. It is remarkable that I have not observed any Psychodids.

CHIRONOMIDAE

Three species of *Orthocladius* are recorded as bred from fungi in California (Kessel & Kessel 1939), two of them from *Coprinus* and the third from *Stereum hirsutum*. One might expect to breed Chironomidae from wet decomposing Agarics, *Boletus*, or *Polyporus squamosus*. None have emerged from material of that type.

Metriocnemus atratulus Zett.—A number of this common insect emerged from old darkened sporophores of *Stereum purpureum*, of the crop of the previous autumn; the material was collected at Gerrards Cross in February, the flies emerging early in April. This is a curious record: in 21 collections of *Stereum* spp. (including 7 of *S. purpureum*) the insect was found only once.

Eudactylocladius icterica M.—One emerged from a collection of *Xylaria polymorpha*, in which *Sciara* larvae were numerous. *X. polymorpha* seldom contains Dipterous larvae. From Gerrards Cross.

CERATOPOGONIDAE

The two fungicolous members of this family both belong to genera in which the majority of species breed in a diversity of other material, indeed *Forcipomyia ciliata* may be reared from material other than fungi.

Forcipomyia ciliata Winn.—Saunders (1923) first called attention to the diversity of life-histories in the members of this genus, described the larvae and pupae of several, and showed how valuable their points of difference could be in a genus in which the adults may be difficult. The larvae were found in many types of environment, associated with decomposing vegetable material. He showed on grounds of larval and pupal structure that *boleti* Kieffer, 1901 (larvae in numbers, on and in decomposing fungi, *Boletus confluens*.) is a synonym of *ciliata* Winnertz, 1852. Saunders found early stages of *ciliata* in rotting Agarics and Polypores, but he also bred the insect from decomposing water weed, raked out on the bank of a river near Cambridge and found larvae in winter inside rotting stems of potato and under bark on a fallen branch.

In my own rearings from Gerrards Cross, *F. ciliata* has not proved common. Many larvae were found, in little groups in a single decomposed Agaric collected in December. Adults emerged in the end of March and in April. The insect was also reared from *Russula ochroleuca* (6/1), collected in October and beginning to decompose. Reared in 1954 from *Armillaria mellea*, rather decomposed, collected October 19th, some hundreds of *F. ciliata* emerging in early November: also a small number from 'ozonium' of *Coprinus*.

The adults only live a couple of days in captivity, even in a moist atmosphere. I offered them syrup, honey, fresh fruit, crushed woodlice, and live caterpillars, but was not able to observe them feed.

Culicoides scoticus Dow. and Ket.—There is no published record of the rearing of *Culicoides* from any fungus. *C. scoticus* was separated by Downes and Kettle (1952) from other members of the *obsoletus* group on the male terminalia. The type was from Glasgow, Lanarkshire, and the species was identified in material from several places, all in Scotland. The breeding places have not been found.

My *Culicoides* material has been examined by Kettle who reports that all the 42 males are *C. scoticus;* the 30 females from the same fungi must be assumed to be the same, and are the first recognised females of that species. My specimens were bred from AGARICACEAE, *Pleurotus cornucopiae* (14/1), *Russula ochroleuca* (6/1); POLYPORACEAE, *Daedalia biennis* (2/1). In 1954 further material was reared from AGARICACEAE, *Hypholoma fasciculare, Lactarius turpis, Armillaria mellea;* BOLETACEAE,

Boletus bovinus. In addition, 3 females of the *obsoletus* group, but no males, were reared from *Polyporus adustus*. Excluding the latter it will be seen that the midge has been reared from seven different species of fungi, on one occasion only from each. It was never numerous, a maximum of a dozen being bred from one collection. All emergences of adults occurred in the autumn. My impression is that this midge is only reared from rather moist fungi, in an early stage of decomposition. To this *D. biennis*, which is rather tough and does not deliquesce, seems to form an exception, but only one midge was bred from it. The discovery of the characteristic breeding place of *C. scoticus* confirms its specific distinctness. Specimens from Gerrards Cross, and Stoke Common, Bucks.

CECIDOMYIDAE

In a recent paper a description was given of a new gall-midge, *Camptodiplosis auriculariae*, bred on many occasions from the fungus *Auricularia auricula-judae*, and reference was made to published information on gall-midges associated with fungi (Buxton and Barnes, 1953).

Lestremia cinerea Macq.—Already recorded from 'mushrooms' (Barnes, 1940). I have reared it from *Stereum purpureum* (7/1), but not from other species of Stereum.

MYCETOPHILIDAE

There are no papers dealing primarily with the biology of European Mycetophilidae, though several authors (e.g. Mansbridge, 1932) have studied a limited number of species. The large systematic papers (*e.g.* Landrock, 1926) contain some facts on food plants and other biological details; Edwards (1925) is particularly valuable as his fungi were often examined by his colleague Dr. J. Ramsbottom. There is some reliable information in Madwar (1934a and b; 1935a and b), Riel (1920), Bonnamour (1926), Barendrecht (1938) and Séguy (1940). Séguy's works (1950, 1951) are of general interest. For North American species see Johannsen (1909-1912, almost entirely systematic), Weiss and West (1920, with careful identification of fungi), and Kessel and Kessel (1939), who have collected many published records, American and European.

Even when the literature has been ransacked one is still ignorant of the biology and early stages of fungus gnats, though they are better known than other Diptera feeding on fungi. I have reared only 36 of the total British fauna of about 400 Mycetophilids. But even among that small number, there were undescribed species of *Sciophila* and *Phronia* (Freeman, 1956). I also established the food plant of several quite common insects: for instance, I have shown that *Trichonta vernalis* feeds regularly on *Calocera cornea*, a common plant. One sees our ignorance also in the large discrepancies, referred to below, between the breeding records of Edwards and of myself, though we both worked in south-east England. These are probably due to a difference in method, for it appears that Edwards examined large amounts of material in the field and selected fragments in which he observed larvae; whereas I have endeavoured not to be selective and collected the material into breeding jars. But whatever the reason the difference in results shows how imperfect knowledge still is, and how far we are from being able to give a general account of the relation between these insects and fungi.

To a very high degree, larvae of Mycetophilidae require their fungus food alive. They differ here from most fungivorous members of the other families. If one picks a toadstool and puts it in a moist atmosphere, one may frequently see hundreds of Mycetophilid larvae (but not other larvae) emerge within 48 hours or even 24 hours. Most of them die of starvation; a few may even make cocoons and then die, presumably due to undernourishment. Methods of trapping the larvae as they emerge from the undisturbed fungus must be developed.

The period passed by these insects in the cocoon (i.e. as a resting larva, pupa and perhaps resting adult) is often very short. For instance, I once

sawdust so that I was able to recover larvae which had emerged within the previous 24 hours: in September the cocoon stage of *Mycetophila ornata* lasted less than 14 days. I had occasion to observe a single cocoon of *Rhymosia domestica* spun against the glass of a breeding tube early in September: the total duration of life in the cocoon was 11 days. I observed a similar duration, 11 days or rather less, in *Mycetophila signatoides*.

It is difficult to understand how a species of Mycetophilid can maintain itself, particularly if it feeds only on a few species of fungi, for the fruiting bodies or sporophores are individually short lived and the period for which they are available may be only a few weeks: moreover, in some years the crop of sporophores may be exceedingly small or none may come up. Even if the insect is prepared to put its eggs on various fungi there are periods in the year when it would be a matter of great difficulty to locate a sporophore. There is an additional difficulty if the insect breeds in small Agarics, especially those which come up singly and not in clumps, such as *Omphalia fibula* and species of *Galerina*. But though these little fungi are not often infested with larvae of Mycetophilidae or other Diptera, they do from time to time produce these insects: this seems to imply that an individual larva may have the power of searching rather widely and feeding on a succession of sporophores.

DITOMYINAE

Ditomyia fasciata M.—Edwards (1925), after referring to the larvae of the subfamily as living 'either in hard Polyporaceous fungi or in rotten wood impregnated with mycelium', says that pupation takes place in the fungus, without formation of a cocoon, the pupae coming to the surface at emergence. As to *D. fasciata* 'its range is probably co-extensive with that of its host fungus (*Polystictus versicolor*) from which it may easily be reared in numbers'. Madwar (1937) also obtained his material of *D. fasciata* from *Polystictus versicolor* and refers to earlier authors who had associated the insect with this fungus: others, however, obtained it from different polypori.

My experience does not entirely agree with Edwards or Madwar. From 16 collections of *P. versicolor*, I have only reared *D. fasciata* on a single occasion, from a collection made in November at Gerrards Cross; though many of the other collections were made in autumn. On the other hand I have bred *D. fasciata* from other POLYPORACEAE, *Fomes ulmarius* (9/3, flies in numbers), *Daedalia biennis* and *Polyporus picipes* (several flies, on a single occasion from each), and *P. adustus* (8/1, only two flies). All the records are from Gerrards Cross. It is to be noted that all the food plants are hard Polypores. I have not bred the insect from 11 collections of the soft *Polyporus squamosus*. One knows from his success with other species that Edwards gave much time to rearing from Polyporaceae and I cannot explain the inconsistency between his results and mine.

BOLITOPHILINAE

Bolitophila.—From the fact that one may rear a couple of hundred flies from half-a-dozen toadstools, it seems evident that the eggs are laid in large numbers, either in mass or close to one another. The relation of the eleven British species to particular food plants merits further study: in some at least the relation is close. So far as is known all the food plants are Agarics.

B. saundersi Curt.—Edwards (1925) said 'this species seems to be specially associated with *Hypholoma fasciculare* in which I have on several occasions found the larvae'. He refers to Audcent who had reared this insect from the same fungus, but also from *Tricholoma personatum*. I have examined five collections of *Hypholoma fasciculare*, and bred *B. saundersi* from two, collected in early April and December: from Gerrards Cross, and Wisley, near Ripley, Surrey. Newly emerged adults copulate in a jar of about half a cubic foot. I have failed to secure a second generation, offering moist reconstituted fungi.

B. cinerea M.—Recorded by Edwards from *Hypholoma velutinum*, and by Falcoz (1924) from *H. sublateritium*. Reared by myself from *H. sublateritium* (1 1) collected in January at Tonbridge. If further experience shows that *B. saundersi* and *cinerea* are associated respectively with *H. fasciculare* and *sublateritium* that will be interesting: the fungi are regarded as closely related.

B. pseudohybrida Lw.—Reared by Edwards from larvae found in the stem of *Clitocybe nebularis*. Reared by myself, a single specimen only, from *Tricholoma nudum* collected

B. hybrida M.—Edwards found the larvae in *Paxillus involutus*, and *Paxillus* sp. Riel (1920) reared the insect (referred to as *B. fusca* Mg.) from *Paxillus lateralis* and *Boletus luteus* in France. Riel, who had an expert knowledge of fungi, recalled the view that *Paxillus* and *Boletus* may be closely related, and observed that this affinity was better appreciated by the female fly than by certain mycologists. This insect was also reared by Madwar (1934a) from *Paxillus involutus*, from near Cambridge, and by Tollet (1953) from the same fungus, on two occasions, in France. Madwar (1937) notes that Degeer (1776) figured a larva, obtained from *Boletus luteus*, which has the structural characteristics of *Bolitophila* sp.

In my investigation I examined two collections of *Paxillus involutus;* one was negative; from the other (Gerrards Cross, collected in October), several hundred *B. hybrida* were bred. I have not reared *B. hybrida* from *Boletus* spp. (12/0).

SCIARINAE

Owing to the difficulty of identification I have no precise records for this subfamily. I have reared *Bradysia* sp., from fungi which are only attacked by very few Diptera, *e.g.* from *Xylaria polymorpha* on several occasions, *Hypoxylon fragiforme* (*coccineum*), *Polystictus versicolor* (16/1) and several species of *Polyporus*, both hard and soft: also from *Auricularia mesenterica* (10/2), but not *A. auricula-judae* 10/0. Falcoz (1921) reared a *Sciara* from *Schizophyllum commune*, an Agaric seldom attacked by Diptera.

Some species of *Bradysia* may easily be maintained for an indefinite number of generations in decomposed fungi: for instance a crop of them may emerge at monthly intervals, in summer, in a closed breeding jar. Certain species referred to *Sciara*, have been reared in 'mushroom meal' and studied by cytologists (see Metz and Moses (1928), Metz and Ullian (1929) and earlier papers by Metz).

SCIOPHILINAE

The common insects referred to below select their food without any regard to the accepted taxonomy of fungi. One may ask why they have not been reared from many more genera of fungi, and what it is that determines the choice.

Mycomyia marginata Mg.—Reared by Edwards from a number of fungi of different families, all growing on bark: POLYPORACEAE, *Poria versipora* (*vaporaria*) and *Polystictus versicolor;* THELEPHORACEAE, *Phlebia radiata* (*merismoides*) and *Stereum hirsutum;* TREMELLALES, *Auricularia mesenterica*. He describes the formation of the webb and suspension of the pupa in it. Reared by myself from *Stereum hirsutum* (7/1), and *S. purpureum* (7/1), from Gerrards Cross. The web is inhabited by a considerable group of larvae.

Sciophila lutea Macq.—Reared by Edwards from *Polyporus giganteus* from which I have not reared it (4/0), and by Falcoz (1921) from *Polyporus nigricans* and *Stereum hirsutum*. I have reared it from a curious assortment: POLYPORACEAE, *Daedalia biennis;* PYRENOMYCETES, *Hypoxylon deustum* (*Ustulina vulgaris*); AGARICACEAE, *Russula ochroleuca* (6/1). From Gerrards Cross, and Burnham Beeches, Bucks.

S. hirta Mg.—Reared by Edwards from POLYPORACEAE, *Daedalia quercina, Poria versipora* (*vaporaria*) and *Polystictus versicolor;* TREMELLALES, *Auricularia* (*Herniola*) *auricula-judae;* AGARICACEAE, *Lactarius volemus* (and oviposition on this fungus witnessed). Chapman (1904) describes the egg and pupa; his material was from *Daedalia quercina*. Reared by myself from DISCOMYCETES, *Bulgaria inquinans;* POLYPORACEAE, *Trametes confragosa* (6/1); AGARICACEAE, *Collybia maculata*. From Gerrards Cross and Tonbridge.

S. buxtoni Freem.—Bred from *Trametes confragosa* (6/1) collected in September, and *T. gibbosa* (5/1) collected in October, from Gerrards Cross. The material is in the British Museum (Nat. Hist.).

Rondaniella dimidiata Mg.—This distinctive insect was described by Edwards as 'rare but widely distributed'. There is no record of its having been bred. Reared five times from fungi collected in the autumn of 1954: CLAVARIACEAE, *Sparassis crispa* (once, in numbers); POLYPORACEAE, *Polyporus adustus* (from two collections, numerous), *Fomes annosus* (from two collections). Adults emerged in November and December, and one in May. From Gerrards Cross and Wisley, Surrey.

Docosia gilvipes Hal.—According to Edwards a fairly common and widely distributed species; reared by him from TREMELLALES, *Auricularia mesenterica;* AGARICACEAE, *Hypholoma fasciculare;* POLYPORACEAE, *Polyporus betulinus*. I have examined a considerable number of collections of the above fungi, but not reared this insect from them. I have, however, reared numbers of it from three Agarics, *Amanita*

muscaria, Clitocybe nebularis, and *Tricholoma nudum;* also a single specimen from the Discomycete, *Peziza* (*Aleuria*) *micropus*: from Gerrards Cross.

MYCETOPHILINAE

Exechia spinigera Winn.—According to Edwards, the adult is common, but he reared it on one occasion only, from *Hygrophorus chlorophanus*. Reared by myself once only, from *Amanita muscaria* at Gerrards Cross.

E. fusca Mg.—Edwards refers to this as 'the commonest species of the genus everywhere with us': he reared it from *Boletus versicolor*, and from 10 Agarics of a wide range of genera. Several of them are rather small, *e.g. Marasmius erythropus*, of which the cap is about 1 inch in diameter. Edwards noted that larvae are found in quite small numbers, generally in the stem. (See also Riel 1920, who reared this insect, referred to as *fungorum*, from two Agarics.) Reared by myself from *Mycena galericulata* a single specimen on one occasion, and from *Trametes gibbosa* (5/1, half a dozen specimens), both from Gerrards Cross. The two fungi are curiously different, the *Mycena* a small and delicate Agaric, the *Trametes* a hard lumpy Polypore.

E. dorsalis Staeg.—Recorded by Edwards from *Boletus* and two genera of Agarics. Reared by myself once, from *Collybia maculata*, from Gerrards Cross.

Rhymosia domestica Mg.—Regarded by Edwards (1925, i.e. before the distinction from *rustica* Edw. was detected) as 'fairly common everywhere'; larvae found in three Agarics, *Tricholoma nudum, Clithocybe infundibuliformis* and *Marasmius oreades*. Reared by myself from similar fungi, *Tricholoma gambosa* (collected May 26th), *Clitocybe geotropa* and *Marasmius oreades*, from the latter 8/3 and in numbers. From Gerrards Cross and Tonbridge.

R. rustica Edw.—A single specimen from one collection of *Tricholoma nudum*, from Gerrards Cross. It would be a matter of interest to investigate whether the closely related species of *Rhymosia* are associated with separate food plants.

R. fenestralis Mg.—This common species was reared by Edwards from a small *Boletus*, and from Agarics of five genera. My records add *Clitocybe geotropa, C. nebularis*, and *Pleurotus corticatus* (1/1). I have examined 22 collections of *Pleurotus* spp., the insect emerging on one occasion only. From Gerrards Cross and Tonbridge.

Allodia lugens Wied.—An abundant widely distributed species recorded by Edwards from *Russula* sp. and *Armillaria mellea*. Reared by myself from *Hebeloma crustuliniforme* and *Pleurotus serotinus* (but not met with in numerous other collections of *Pleurotus* sp.). From Chobham, Surrey, and Gerrards Cross.

A. ornaticollis Mg.—An abundant insect, recorded by Edwards from Agarics of four genera. Reared by myself from *Hebeloma crustuliniforme* (several, from one collection) and *Hygrophorus virgineus* (one only). From Chobham, Surrey, and Gerrards Cross.

A. silvatica Land.—Edwards gives no food records. Reared by myself from the Discomycete *Peziza* (formerly *Aleuria*) *repanda* (8/4, in numbers), from Gerrards Cross. These records, and that of *A. triangularis* below demonstrate the importance of exploring the fungi widely. The Discomycetes, and the same might be said of other groups such as the Pyrenomycetes, have been neglected by entomologists.

A. triangularis Strobl.—A rare insect, of which the British Museum only has two males, from Scotland, apart from my material. Reared from *Peziza* (*Aleuria*) *repanda* (6/1, a few specimens, among many *silvatica*); from Gerrards Cross.

Brachypeza radiata Jenk.—Edwards found the larva of this insect 'abundant in a fungus (*Pleurotus* sp.) which grows on old but standing elm trunks. I have never failed to find them in this fungus, nor on the other hand have I ever found them elsewhere': Hamm found larvae in the same fungus. Madwar (1937) found larvae in *Pleurotus* on elm trees at and near Cambridge, in August, September and November, and adults all the year round. I failed to rear it from 14 collections of *Pleurotus cornucopiae* from elms, or from 8 collections of other species of *Pleurotus*, some from elms: most of above from Gerrards Cross.

Cordyla nitidula Edw.—In his original description Edwards (1925) says that 'the specimens were all reared from fungi of the genus *Russula* (*R. chloroides, R. lutea* and another species).' In my experience reared once only, from *Russula ochroleuca* (6/1, a single fly), collected in early October, Gerrards Cross.

Trichonta vitta Mg.—Regarded by Edwards as common and reared repeatedly from *Poria versipora* (*vaporaria*). In my experience reared once, from the same fungus collected in December at Cranbrook, Kent.

T. vernalis Land.—I have reared half-a-dozen, on a single occasion, from *Calocera cornea* collected October 23rd at Gerrards Cross. The larvae were bright yellow, presumably from the colouring matter of the fungus. They emigrated from the fungus on November 12th and made cocoons, from which adults emerged December 5th to 7th. On several other occasions I have observed yellow larvae, doubtless of this species, in *C. cornea*, but failed to rear adults.

Phronia sinuata Freem.—I have reared this species from *Calocera viscosa* (6/2 several specimens on both occasions) in September and December, from Gerrards Cross. It has not been reared from *C. cornea* (5/0), nor from a number of collections of other Tre-

So far as they are known (Edwards, 1925: 623, 627; Madwar, 1937), larvae of *Phronia* live externally, generally on the surface of dead branches, sodden and attacked by moulds. The known larvae fall in three groups, (*a*) whitish, without cases, with a thin coating of mucous (*P. forcipula, tarsata, conformis*); (*b*) 'covered with a thick black slimy covering and therefore particularly slug-like' (*P. annulata*); (*c*) 'bearing regular and fairly hard conical black cases resembling tiny limpets' (*P. strenua*). The larva of *P. sinuata* is bright yellow from ingested *Calocera*, but otherwise falls in the first group, except that it is an internal feeder in the finger-like growths of the fungus. The larvae of most species, of which Edwards (1925) gives 24 as British, are not yet known. It is not yet possible for the taxonomist to take much account of these considerable differences between living larvae.

Of *Phronia forcipula*, Edwards (1925) says that he 'reared specimens from whitish, non-case bearing larvae sent me by Mr. J. C. F. Fryer from Kew. The larvae were said to occur in such numbers on a certain fungus of the genus *Corticium* as to render its cultivation almost impossible'. It is difficult to interpret this word 'cultivation': perhaps as Dr. Dennis has suggested, 'cultivation' is a misprint for 'identification'. Miss E. M. Wakefield, formerly on the staff of the Herbarium at Kew, and a specialist in *Corticium*, tells us that she has frequently found numerous cream-coloured larvae with a mucous sheath in *Corticium* (*Glœocystidium*) *praetermissum*, but that she has not noticed them in other species of *Corticium*.

Dynatosoma fuscicorne Mg.—Reared by Edwards from a number of POLYPORACEAE, *Polyporus squamosus, P. betulinus, Polystictus versicolor, Daedalia quercina* and *Lenzites betulina*. Madwar (1935a) also reared it from the first two of these. I have reared it from *Daedalia biennis* (2/2), but never from the fungi mentioned by Edwards; for instance *P. squamosus* (11/0) and *P. versicolor* (16/0).

Mycetophila fungorum Deg.—According to Edwards, this insect is hardly ever absent from *Armillaria mellea*, which he regards as its 'natural food-plant'. He also bred it from several species of *Boletus* and Agarics of a number of genera. I have reared it from *Armillaria mellea* (3/1), *Pluteus cervinus*, and *Hebeloma crustuliniforme;* also from *Polyporus squamosus* (11/1), a single specimen, presumably accidental, for this is the only record from the POLYPORACEAE. From Chobham and Gerrards Cross.

M. lineola Mg.—Reared by Edwards from *Sparassis laminosa* and from seven Agarics. In my collections reared from *Hebeloma crustuliniforme*, and *Polyporus squamosus* (11/2, but in numbers on both occasions). From Chobham and Gerrards Cross.

M. ocellus Walk.—'Common everywhere, and breeds in varius bark-growing fungi' (Edwards). He records it from members of four families, *Poria versipora, Phlebia merismoides, Sparassis crispa* and *Pleurotus ostreatus*. I have bred it in numbers from a PYRENOMYCETE, *Hypoxylon deustum* (*Ustulina vulgaris*); THELEPHORACEAE, *Corticium laeve* (7/1), *Corticium* sp.?, *Coniophora puteana, Stereum purpureum* (7/1): all from Gerrards Cross. I have not reared it from other *Stereum* spp. (14/0), nor from *Pleurotus* spp. (22/0), indeed Edwards' record from *P. ostreatus* is the only one from an Agaric. The distribution of host plants is curious, but all grow on bark, as Edwards remarked.

M. formosa Lund.—Reared by Edwards from *Phlebia merismoides*; by myself from the very closely related *Phlebia radiata* (1/1, two only), from Gerrards Cross.

M. ornata Steph.—Edwards bred this insect from 'various bark-growing fungi, including *Polystictus versicolor, Polyporus giganteus, Stereum* sp., and *Pleurotus ostreatus*. My records are from *Polyporus giganteus* (4/1) and *Pleurotus ostreatus* (4/2, in numbers). I have not reared it from other species of *Pleurotus*, nor from *Polystictus versicolor*: from Gerrards Cross. The cocoon is cylindrical and fragile, and the ends of the cylinder are looser than the sides. When I have been examining cocoons I have seen the adult insect suddenly emerge from the end and fly away. I have put numbers of bred *M. ornata* in a jar with wet reconstituted fungi (*Boletus, Lycoperdon, Auricularia* and Agarics, all in one jar, on sawdust). After dark they ran over the surface of the fungi, probing with the abdomen. No larvae developed.

M. marginata Winn.—According to Edwards, the larvae feed in bark-growing fungi: he mentions several POLYPORACEAE, also *Stereum* sp. and an undetermined Agaric in fallen elm. Madwar (1935a) reared the insect from *Poria versipora* and *Polystictus versicolor*. My records are from *Collybia velutipes* (an Agaric, growing on old trunks of elder, *Sambucus*), *Fistulina hepatica*, and *Xylaria hypoxylon* (8/1, a single adult). The last fungus is seldom associated with larval Diptera. From Gerrards Cross and Tonbridge.

M. finlandica Edw.—Reared once from *Tricholoma rutilans* (numerous flies, October, Gerrards Cross).

M. luctuosa M.—An insect with a curious list of food plants, of several families, some growing on bark, others on the ground. Edwards reared it from *Paxillus involutus* (an Agaric doubtless growing on the ground), and an undetermined Agaric on an oak trunk. I have reared it from *Russula ochroleuca*, an Agaric on the ground (6/1 several specimens), also from *Hypoxylon deustum* (*Ustulina vulgaris*), and *Stereum purpureum*; both grown on dead wood, the first a PYRENOMYCETE, the second THELEPHORACEAE. From Gerrards Cross.

M. signatoides Dzied.—Recorded by Edwards as bred from *Boletus*. Reared by myself once only, from *Russula nigricans*, from Gerrards Cross.

M. trinotata Staeg.—Edwards regarded it as specially associated with *Polystictus versicolor* from which he reared it on several occasions, but he also had it from *Polyporus adustus*. I have reared it from *P. adustus* (8/2, in May and November), but never from *Polystictus versicolor* (16/0). From Gerrards Cross.

M. cingulum Mg.—Edwards bred this insect, on several occasions, and 'exclusively' from *Polyporus squamosus*. I also have it from the same fungus (11/1, several specimens, in May). From Gerrards Cross.

Platurocypta punctum Stann.—Bred on several occasions, and in numbers, from the Myxomycete *Lycogala epidendrum* (Buxton, 1954). I regarded it as an interesting discovery that Diptera feed in Myxomycetes, but Perris (1839) has priority by more than a century. The author collected Dipterous larvae in '*Lycogala miniata*' in the Landes, France: *Miniatum* Persoon is given by Lister as a synonym of *L. epidendrum* Fries, and Dennis assures me that there is no reason for interpreting it otherwise. The larvae produced an insect described and figured by Perris (1839) as *Mycetophila lycogalae*. Mr. P. Freeman has examined Perris's description and figure, and writes to me that 'Neither fits *Platurocypta punctum* at all well . . . without examination of the type it is not possible to be certain of the identity of the species'. In any case the synonymy would not be disturbed for *punctum* Stannous, 1831, has priority.

SCATOPSIDAE (BIBIONIDAE)

It is supposed that Scatopsidae breed in decomposing vegetable material, and are not specific. That view is supported by the few records of these insects reared from fungi. Bonnamour (1926) has reared *Scatopse flavicollis* Mg. from *Tricholoma pessundatum* in France. *Rhegmoclema atrata* Say was bred from two unrelated fungi, *Stereum hirsutum* and *Mycena* sp., near San Francisco, California (Kessel & Kessel, 1939). Undetermined Scatopsid larvae are recorded from inside a polypore, in Morocco in October, by Séguy (1940).

Scatopse fuscipes Mg.—I have reared this cosmopolite insect from *Fistulina hepatica* and *Polyporus squamosus*, once from each; Gerrards Cross and Tonbridge.

S. picea var. *scutellaris* Lw.—One emerged in January, 1955, from *Polyporus adustus* collected in November, 1954, in Gerrards Cross. Freeman states that the determination follows Edwards not Duda.

ANISOPODIDAE

Anisopus cinctus F.—From *Bulgaria inquinans* (twice) and *Pleurotus ostreatus*, once. Having regard to the large number of collections (22) of *Pleurotus* spp. examined, it seems that this insect is no more than occasional. There are no records of this insect being reared from the variety of decomposing vegetable materials so frequently inhabited by larvae of *A. fenestralis*. The evidence suggests that *A. cinctus* may be particularly associated with fungi, presumably when decomposing. It is easy to maintain *A. cinctus* in a cage for a number of generations, on 'reconstituted' fungi. From Gerrards Cross and Tonbridge.

SCENOPINIDAE

Scenopinus fenestralis L.—Bred in August from *Polyporus hispidus*, at Vienne, Dauphiné, France: other records quoted suggest that the insect is a miscellaneous scavenger (Falcoz, 1922).

EMPIDIDAE

Drapetis nigritella Zett.—Two were reared from young plasmodium of *Fuligo septica* (Myxomycetes), but none from considerable quantities of older material: the relation to the Myxomycete was regarded as doubtful (Buxton, 1954). Dr. B. R. Laurence has bred this insect from fairly old cow pats, but not from fresh ones. He suspects that the larvae feed on fungi in cow pats.

DOLICHOPODIDAE

Systenus scholtzii was reared by D. Sharp from a fungus on beech in the New Forest, Hants (Verrall, 1905). Larvae of many species of the genus *Medeterus*, to which both my records relate, feed on larvae of bark beetles, and pupate under bark (Collin, 1941). My records, both of them from bark-growing fungi, may be due to mature larvae which chanced to pupate in this material. *M. apicalis*, of which a number were reared, only occurred once, from numerous collections of *P. cornucopiae*. Only a single specimen of *M. impiger* was bred, but there are two more in the British Museum labelled 'bred from larch' (Collin, 1941).

Medeterus apicalis Zett.—Several males (and females doubtless co-specific) bred from *Pleurotus cornucopiae* (14/1), on bark of a dead elm log, Gerrards Cross, collected in July.

M. impiger Coll.—One male, bred from *Daedalia biennis* (2/1) growing from a dead stump, Gerrards Cross, September.

PHORIDAE

Schmitz (1948) finds that most of the fungivorous species belong to the subgenus *Megaselia*, within the enormous genus *Megaselia*; this particular habit is characteristic of four groups of species. There is also a fungivorous group within the subgenus *Aphiochaeta*. Colyer (1954) described a species reared by myself, and listed the British fungivorous species, 5 in the Phorinae, 26 (all *Megaselia*) in the Metopininae. My earlier finds were included by Colyer, but three are now added to his list. I am indebted to Mr. Colyer, and before him Mr. Collin, for examining and identifying my material.

Certain Phorids which have been bred from fungi feed also on other substances, *e.g. Megaselia giraudii* has been bred from a living grasshopper and *M. rufipes* is also a facultative parasite (Colyer, 1954). It will be a matter of great interest to discover whether some fungivores are limited to that food material, and how specialised they are within the fungi. The limited amount of information available (Colyer, 1952) indicates that *Triphleba minuta* F. feeds only on the Agaric *Pholiota spectabilis*.

The difficulties in identification of Phorids are perhaps greater than appeared a few years ago, and the synonymy is far from stable. With all respect to the authors, it seems wisest to disregard identifications published before Schmitz's paper of 1948, *e.g.* those in the papers by Dufour (1840), Riel (1920), Bonnamour (1926) and Kessel & Kessel (1939). Papers dealing with cultivated mushrooms (*Psaliota hortensis*) mention Phoridae as major pests, feeding in the mycelium in the bed, and also entering the previously undamaged stem and cap (Thomas (1942), Min. Agric. & Fisheries (1950)).

Fungus-eating Phorids are not frequently reared. My records are from 10 species, and 17 collections of Agarics, roughly a tenth of the total species and collections. When Phorids occur they may be extremely numerous, hundreds sometimes emerging within a few days. They are associated with decomposing materials, but the species which feed in fungi, or at least some of them, oviposit in the young fresh plant and may be reared from fungi picked in that state. My specimens have been bred from conspicuously soft plants; the majority are such Agarics as *Pleurotus* and *Russula*. The only Discomycete is *Peziza (Aleuria)*, and the only Polypores, *P. squamosus* and *fumosus*. The food-fungi recorded by Schmitz (1948) are also soft, and include a number of *Boletus* spp. There is probably enough evidence to say that Phorids do not consume hard, woody Polypores, or Pyrenomycetes.

Megaselia giraudii (Egg.).—Reared from *Pleurotus cornucopiae* (14/2) and *Coprinus micaceus* (12/1), from Gerrards Cross.

M. flava (Fall.).—From *Peziza (Aleuria) repanda* (8/2), from Gerrards Cross.

M. impolluta (Schmitz).—From *Pluteus umbrosus*, from Gerrards Cross.

M. lutea (Mg.).—From *Russula ochroleuca* (6/2), from Gerrards Cross.

M. scutellariformis (Schmitz).—from *Russula ochroleuca*, *R. vinosa*, and *Tricholoma atrocinereum*, from Gerrards Cross.

M. rufipes (Mg.).—From *Bolbitius titubans*, from Seahouses, Northumberland.

M. pygmaeoides (Lund.).—From *Russula ochroleuca* (6/1), *Tricholoma gambosa*, and *Coprinus* (?) *micaceus* (12/1); from Gerrards Cross and Tonbridge.

M. sylvatica (Wood).—Mr. Colyer (*in litt.*, 6.x.54) states that the insect he had identified as *M. nigrescens* (Wood) is *sylvatica* (Wood), a conclusion reached by Father Schmitz and himself. After examining Wood's types, Colyer finds that 'what I have always regarded as *nigrescens* is Wood's *sylvatica*, and that Wood's *nigrescens* is in fact a separate species but very close . . . .' *M. sylvatica* is an addition to the list of British fungicolous Phorids: *nigrescens* Wood is not to be deleted, for there is British material of that species, recorded by Schmitz. My material was reared from *Coprinus radians*, from Gerrards Cross.

M. imberbis Schmitz.—From *Pleurotus cornucopiae* (14/1), from Gerrards Cross.

M. buxtoni Colyer.—Described by Colyer (1954) from material of both sexes reared by myself from *Pleurotus cornucopiae*, from Gerrards Cross. Subsequently bred on several occasions (14/3 in all) from the same fungus; also from *Polyporus squamosus* (11/2), and *P. fumosus*; all from the same locality. The species belongs to the '*fungivora*-group, within Lundbeck's Group II'. It is closely related to *imberbis* Schmitz and *frameata* Schmitz.

M. cinereifrons (Strobl).—Reared from *Merulius corium*, from Gerrards Cross. An addition to the list of British fungivorous Phoridae.

M. frameata Schmitz.—Recorded once only from Britain (Colyer 1954). Several emerged in April from *Hypoxylon multiforme* collected at Gerrards Cross in February, 1955.

PLATYPEZIDAE

All Platypezid larvae live in fungi. Czerny (1930) made a careful collection of European records of rearing, which may be tabulated thus, indefinite references to 'Pilze' and 'fungus' being omitted:

Platypeza (Clythia) dorsalis Mg. (*holoserica* Mg.)	*Agaricus campestris* Dufour, 1840
Platypeza (Clythia) dorsalis Mg. (*holoserica* Mg.)	*Agaricus campestris* Perris, 1876
Platypeza (Clythia) subfasciata Mg.	*Agaricus campestris* Perris, 1876
Platypeza (Clythia) boletina Fln.	**Boletus pruni cerasi* Zetterstedt, 1844
Platypeza (Clythia) fasciata Fln.	**Boletus pruni cerasi* Zetterstedt, 1844
Platypeza (Clythia) fasciata Fln.	*Lepiota polymyces* Frauenfeld, 1864
Platypeza (Clythia) infumata Hal.	*Polyporus* de Meijere, 1901
Calomyia amoena Mg.	'fairy rings' Sznall, 1881
Calomyia amoena Mg.	*Corticium* Lundbeck

Bonnamour (1926), working in France, reared *Platypeza picta* Mg. from *Polystictus (Polyporus) versicolor*, a single specimen. Willard (1914) described *Platypeza agarici* and *polypori* from Stanford University, California (to judge from the title of his paper, for there are no localities in the text). Large numbers of *Platypeza agarici* were reared from a cluster of *Agaricus californicus*. The larva, which is figured, fed on the soft tissues at the base of the gills, and pupated on the surface of the fungus, or in the soil in the breeding jar. *P. polypori* was reared from *Polyporus*. Kessel & Kessel (1939) worked at the University of California and presumably collected their material in that neighbourhood. They reared *P. agarici* from a species of *Marasmius*, and *P. polypori* from *Polystictus versicolor*.

Platypeza furcata Fall.—Reared on three occasions (11/3, numerous) from *Polyporus squamosus*. From Gerrards Cross and Tonbridge.

P. modesta Zett.—Reared (9/1, in small numbers) from the puff-ball *Lycoperdon pyriforme*, collected in August, adults emerging the following May; from Gerrards Cross.

P. fasciata Mg.—Reared from *Lycoperdon pyriforme* (the same collection that produced *P. modesta*), small numbers emerging in May.

SYRPHIDAE

Early authors, starting with Réaumur, were aware that there are Syrphid larvae in truffles and other subterranean fungi. Goureau (1852) described the caudate larva and the pupa which he states was 'smooth', the female fly being 'analogue' with *Cheilosia scutellata* Macq., and the male with *mutabilis* Macq. Dufour (1840) had bred Syrphids, which he identified as *Cheilosia scutellata*, but his material was from *Boletus*, particularly *B. edulis and pinetorum*. Larvae collected in June produced pupae in July, and adults in August: but larvae collected in November did not pupate until the spring and produced adults in September. The larvae (figured) often occurred in numbers. Dufour (1853), directed Goureau's attention to the paper of 1840, and insisted that his insect from *Boletus bovinus*, with a downy pupa, was *C. scutellata*. As to the insects from truffles seen by Réaumur, and by Goreau, he suggested that they were no doubt 'similar to' *scutellata*. Laboulbène (1864) gave a balanced account of the matter and clearly held that there were two Syrphids, that from *Boletus* with a downy pupa, that from truffles smooth. Verrall (1901), under *C. scutellata*, said that there are two specimens in Bigot's collection labelled '*tubericola* Laboulbène': the male was *scutellata*, the female *soror*: they represented the species mentioned by Laboulbène as bred from *Boletus*. Verrall gave no

**Boletus* here evidently signifying a Polyporaceous fungus.

other records of *Cheilosia* sp. from fungi. This confusion surely requires the examination of specimens bred from truffles, and from *Boletus*.

There are no British records of Syrphids reared from fungi, though *C. scutellata*, referred to above, is one the British list; other species of the genus are known to feed in a variety of plant tissues (Coe, 1953).

Cheilosia longula Zett.—In 1954 I collected *Boletus bovinus* at Stoke Common, Bucks., on October 3rd and 10th, and both sexes of this species (det. R. L. Coe) emerged from the end of May until July, 1955. Several specimens also emerged from *Boletus luridus* collected on October 3rd at the same place.

OTITIDAE (ORTALIDAE)

Weiss & West (1920) record *Pseudotephritis vau* Say from *Lenzites betulina* and *Polyporus hirsutus*, both in New Jersey. The genus *Pseudotephritis* is purely North American.

DRYOMYZIDAE

Townsend (1893) states that larvae of *Dryomyza* occur in fungi. No further information is available.

SAPROMYZIDAE

Dufour recorded *Sapromyza* from fungi: in his second paper he corrected this and stated that the insect was Calyptrate, and referable to *Anthomyza* (Dufour, 1839-1840). This error is perhaps the origin of the statement by Townsend, 1893, that *Sapromyza* has been reared from various decaying material and from fungi.

DROSOPHILIDAE

There are a number of unsatisfactory records of species of *Drosophila* bred from unnamed fungi. To quote the earliest only, Haliday (1833) bred *D. cameraria* 'from Boleti' at Holywood in Downshire. Dufour (1840) records *D. fasciata* and *maculata* as fungivorous. Spencer (1942) makes the sound point that members of the *D. quinaria* group (which includes *phalerata, transversa*, and the American *munda*) feed regularly on fungi in the larval stage.

Basden (1954a) has recorded information on the relation between species of *Drosophila* and toadstools in Scotland. He records both those species which had been bred from toadstools, and those which as adult flies visit fresh or decomposing toadstools. He distinguishes between toadstools growing on the ground and those growing on trees, but does not publish identifications. Basden points out that three species of *Drosophila* (*phalerata, transversa* and *cameraria*) breed exclusively, or almost so, in healthy toadstools. The first two are closely related and belong to the *quinaria* group of species; *cameraria* is not closely related to them. His paper includes a photograph of the Agaric, *Russula cyanoxantha* with eggs of *D. phalerata* and *cameraria* embedded in the surface of the pileus or cap. Basden informs me by letter that he has reared these two and also *transversa* from that toadstool, near Edinburgh. He can distinguish the egg of *cameraria* which has four thin filaments from that of *phalerata* with two thin and one longer and thicker filament and he has shown me a preserved specimen in which this difference may be observed. Basden finds that *D. transversa* is the rarest of the three in the Edinburgh district and *phalerata* the commonest: the latter is also capable of breeding in a wider range of fungi than the others, but this doubtless requires fuller and more precise investigation.

Basden finds that, in Scotland, three other species of *Drosophila, D. funebris, busckii* and *subobscura*, are less specialised; they have been reared from toadstools among other things. *D. subobscura* has been reared on several occasions from fresh toadstols: the adult has been found only at

species in an 'autumn flush' of *Drosophila* at Edinburgh in November, 1950. These flies were rare in the cold weather, but *subobscura* again became the commonest species in February and March. A few adult *D. cameraria* and *phalerata* were caught in autumn and spring, and *cameraria* also in winter (Basden, 1953). Wild *D. subobscura* females have undeveloped ovaries from November to February: some show fully developed eggs in March (Basden, 1954b). Basden (1954a) has reared *funebris* and *busckii* from decaying toadstools collected in a heap, but not from healthy ones; *funebris* has been bred from many other types of fermenting material as well. The adults of these three species may be caught at toadstools.

Basden records an adult *Scaptomyza graminum* (Fall.) taken on a bracket fungus near Edinburgh: the larva is a leaf miner (Basden, 1954a: 648).

Amiota alboguttata (Wahlberg) has been bred from the Pyrenomycete *Daldinia concentrica* collected from burnt birch at Studland Heath, Dorset, August, 1935, adults emerging in the following June and July. The puparia are to be found in the fungus (Edwards, 1936; Wakeley, 1953, reared this insect from the same fungus, in Surrey, adults emerging in June). The larva of *A. alboguttata* perhaps feeds only on *Daldinia*.

Riel (1920), in France, bred *Drosophila phalerata* from the following Agarics: *Russula nigricans, R. adusta, R. virescens, R. cyanoxantha, Collybia dryophila, C. grammocephala, Tricholema inamoenum, Cortinarius collinitus, Amanita phalloides, A. pantherina* and *A. rubescens*; also *D. transversa* from *Russula depallens, R. cyanoxantha* and *Boletus bulbosus*. Falcoz (1924) working at Vienne in the Dauphiné records *D. unistriata* Strobl from *Polyporus hispidus* and *P. intybaceus*; *D. obscura* Fall. from *P. hispidus*; *D. histrio* Mg. from *P. intybaceus*; *D. phalerata* from *Lactarius piperatus*. Bonnamour (1926) records the following from French localities: *Drosophila phalerata* from *Russula foetens* and *Tricholoma album*; also *D. rubrostriola* Beek. from *Russula integra, Paxillus involutus, Clitocybe gigantea* and *Boletus edulis*.

From what is in print, and my own records, one sees that no species of *Drosophila* is restricted to one or a few fungus food plants. The larvae of all species feed on many soft fungi. Agarics preponderate, but soft Polyporaceae, are used and in one instance a Discomycete. *Amiota alboguttata* behaves quite differently, the larva feeding in the hard *Daldinia* (Pyrenomycetes).

Drosophila phalerata, transversa and *cameraria* comprise the species known to specialise in breeding in healthy fungi. When *Drosophila* occurs in a sample of fungus, large numbers are generally present.

Drosophila phalerata Mg.—Reared from AGARICACEAE, *Pleurotus cornucopiae, Coprinus micaceus, C. radians, Psathyrella pygmaea*; BOLETACEAE, *Boletus* sp.; POLYPORACEAE, *Polyporus squamosus*; once only from each species of fungus. Collected from June to August, Gerrards Cross.

D. transversa Fall.—Reared from AGARICACEAE, *Coprinus micaceus* (12 ♀♀), *Coprinus* sp., *Psathyrella disseminata*; DISCOMYCETES, *Peziza* (*Aleuria*) *repanda*. (8 ♀); PYRENOMYCETES, *Hypoxylon deustum* (*Ustulina vulgaris*). Collected from May to August, Gerrards Cross and Tonbridge.

D. cameraria Hal.—Reared once from *Russula luteotacta* collected in August at Tonbridge.

D. funebris F.—Bred from AGARICACEAE, *Lactarius piperatus* and *Clitocybe geotropa*; POLYPORACEAE, *Polyporus giganteus, dryadeus* and *fissilis*. Collected from August to November, Gerrards Cross and Tonbridge.

D. repleta Woll.—Reared from *Lactarius vellereus* and *Paxillus involutus*, collected in August at Tonbridge. Also bred from the Myxomycete, *Fuligo septica* (Buxton, 1954).

D. vibrissina Duda.—Bred from AGARICACEAE, *Lactarius vellereus, L. piperatus, Pleurotus cornucopiae*; POLYPORACEAE, *Polyporus squamosus* (12 ♀♀), *fissilis*, and *sulphureus*. Collected from May to August, Gerrards Cross and Tonbridge. The most

D. subobscura Coll. and *buskii* Coq.—Both have been bred from fungi and other materials (Basden, 1954a).

Leucophenga maculata Duf.—Bred from *Pleurotus cornucopiae, Polyporus squamosus* and *Hypoxylon deustum* (*Ustulina vulgaris*) collected in June, July and August at Gerrards Cross.

SEPSIDAE

Nemopoda nitidula Fall.—Reared once from a plasmodium of an unidentified Myxomycete (Buxton, 1954). It is probably a general scavenger.

ASTEIDAE

Leiomyza laevigata Mg.—Reared twice from *Pleurotus cornucopiae* from Gerrards Cross.

BORBORIDAE

Prof. O. W. Richards informs me that one British Borborid, *Leptocera parapusio*, is reared from fungi and not commonly found in any other material: females are much more frequent than males. Adults of one or two species of *Copromyza* (*Borborus*) are found on toadstools: the species have not been reared.

Leptocera parapusio Dahl.—A number (det. O. W. Richards) emerged during October from *Russula ochroleuca* collected at Gerrards Cross in September.

HELOMYZIDAE

Breeding records are not numerous, but larvae of certain Helomyzids feed in subterranean fungi, of others on various fungi on the surface of the ground. As to the first, of which I have no experience, Dufour (1840) and Laboulbène (1864) deal with species occurring in France. Falcoz (1921) remarks that species of *Suillia* (=*Helomyza*) and *Allophyla* have been bred from subterranean Ascomycetes, *Tuber* and related forms: he was probably referring to early French authors. *Helomyza variegata* has been bred from a 'tree fungus', and *H. humilis* 'has been bred from truffles by Dr. Norman Joy': several other species have been reared from nests of certain mammals and birds (Collin, 1943). As to surface growing fungi, Kessel & Kessel (1939) reared *Suillia limbata* Thom. from *Lepiota rhacodes* and *Tricholoma* sp., both of them Agarics. Falcoz (1921) reared *H. variegata* in Vienne, Dauphiné, from *Hypholoma fasciculare*. Bonnamour (1926) records *Helomyza fuscicornis* Zett. from *Clitocybe gigantea* and *Amanita citrina*; also *Helomyza notata* from *A. citrina, Tricholoma pessundatum* and *Clavaria formosa* (a single specimen); all from localities in France.

Helomyza variegata Lw.—Reared from an extremely wide selection of fungi:- DISCOMYCETES, *Peziza* (*Aleuria*) *repanda*; TREMELLALES, *Auricularia auricula-judae*; POLYPORACEAE, *Polyporus giganteus, P. squamosus*, BOLETACEAE, *Boletus versipellis*; AGARICACEAE, *Pleurotus cornucopiae, Russula luteotacta, Amanita* sp., *Pluteus cervinus, Paxillus involutus*, and the ozonium of *Coprinus*. *Auricularia* produces a very limited number of species of Diptera: this is even more true of the ozonium, a dry tough mat from which, however, I have on one occasion (16/1) reared several *H. variegata*. It is unlikely that the presence of several larvae was accidental, and it is supposed that the ozonium is an occasional food plant. In summer, adults emerge about a month after the fungi are collected. Larvae collected in late autumn pass the winter in that stage in the moist sawdust in a breeding jar, and become puparia in the spring. From Gerrards Cross and Tonbridge.

Helomyza notata Mg. var. *hilaris* Zett.—Reared in considerable numbers on a single occasion, from *Entoloma rhodopolium*, collected in November, flies appearing in March; from Gerrards Cross.

H. bicolor Zett.—Reared from PYRENOMYCETES, *Hypoxylon fragiforme (coccineum)* (3/1, half-a-dozen), BOLETACEAE, *Boletus versipellis*; AGARICACEAE, *Amanita muscaria, Armillaria mellea, Tricholoma atrocinereum, T. cuneifolium, T. nudum, Laccaria laccata, Mycena inclinata, M. galericulata, M. epipterygium, Entoloma rhodopolium, Hebeloma crustuliniforme, Psilocybe elongata*; GASTEROMYCETES, *Lycoperdon pyriforme* (9/1, only a single fly). The last record might, perhaps, be attributed to a full fed larva which had pupated in the puff-ball (see, however, the record of several *Tephrochlamys tarsalis* reared from this fungus). The rest of the list is curious. Most of the fungi are large soft Agarics, but there are no records from *Pleurotus* spp. (22/0), or Polypores, even from the moist *P. squamosus* (11/0). The record of several specimens from

erally produces no Diptera. From fungi collected in summer or early autumn, flies emerge after about a month. The insect winters as a larva, becoming a puparium in midwinter or early spring, the adult emerging from March to May. From Gerrards Cross, Stoke Common and Chobham, Surrey.

H. fuscicornis Zett.—Reared from *Clitocybe nebularis*, collected in November, flies appearing in April; from Gerrards Cross.

Tephrochlamys tarsalis Zett.—Reared from CLAVARIACEAE, *Clavaria inaequalis* (4/1), but not from a considerable number of collections of other species of this genus; POLYPORACEAE, *Polyporus giganteus* (4/1, in numbers); AGARICACEAE, *Amanita muscaria; Armillaria mellea, Tricholoma nudum, T. atrocinereum, Coprinus micaceus*; GASTEROMYCETES, *Lycoperdon pyriforme* (9/1 four specimens). As with *H. variegata* and *bicolor* the list is remarkable. *Clavaria* are not commonly food plants of Diptera; the record from the puff ball, *L. pyriforme* should be accepted, based as it is on several specimens. The larva overwinters in the soil. From Gerrards Cross.

Tephrochlamys rufiventris Mg. var. *canescens* Mg.—One reared from the Pyrenomycete, *Hypoxylon fragiforme* (*coccineum*), from the same collection that produced *H. bicolor*; collected at the end of April, the fly emerging in May; from Gerrards Cross.

Neoleria ruficeps Zett.—Two females emerged from *Amanita muscaria*; collected in November, at Sevenoaks, Kent.

Allophyla atricornis Lw.—Reared from AGARICACEAE, *Amanita phalloides, Mycena galericulata, Lactarius vietus*; collected September to November, flies appearing in April and May; from Gerrards Cross.

MUSCIDAE

Keilin (1917) and Muirhead Thomson (1937), only refer incidentally to fungi as breeding material. I have gained a few records from these papers and from other sources referred to under the separate species.

Muscids are relatively infrequent in fungi and I have reared only 14 species from 28 collections. When a predatory larva occurs it does not generally exterminate the other Dipterous larvae, so that one may breed a predator and a considerable variety of other flies: see records below under *Muscina assimilis, Mydaea urbana* and *Mydaea spinipes* (the last presumed to have a predacious larva). Of the species which do not have carnivorous larvae *Pegomyia winthemi* breeds, solely perhaps, in various species of *Boletus*. In general Muscids have emerged from soft fungi such as common Agarics, *Boletus* and *Polyporus squamosus*. *Fannia canicularis* may be a partial exception, for I have reared it from a rather harder plant *Fistulina hepatica*, and even from the woody *Polyporus dryadeus*. One or two authors have recorded breeding Muscids from fungi which were somewhat decomposed. That probably means that the larvae are not full-fed until the soft fungus is decomposed, as is natural enough: there is no evidence that the female fly chooses decomposing fungi for oviposition.

Muscina stabulans Fall.— Keilin (1917: 420) states that the larvae may be either carnivorous or saprophagous. They feed on a variety of decomposing substances or on other larvae. Reared once, in numbers, from *Pleurotus cornucopiae*; from material collected in June at Gerrards Cross, adults emerging July. In spite of the presence of numerous larvae which are potentially predatory, this collection yielded adult *Erachypeza radiata* (one), numerous *Drosophila phalerata, Metalimnobia bifasciata, Megaselia buxtoni* and several *Leptocera*.

M. assimilis Fall.—Keilin quotes authors who reared this fly (in France and Germany) from *Boletus edulis* and *Agaricus campestris*. He found larvae in decomposed remains of *A. campestris*, with larvae of other flies. He observed that the female *M. assimilis* would force her way into an incompletely closed box and oviposit in fermenting mushrooms. She would also place eggs on a closed breeding box in such a way that the emerging larvae could make their way in through a small crack. Keilin also observed larvae of *M. assimilis* in a variety of decomposing animal and vegetable materials. The larva of this insect was shown to be predatory, ripping open and devouring other maggots. Riel (1920) reared it from *Russula virescens* (collected in August, adults emerging the same month), also from *R. depallens, Amanitopsis virginata* and *Polyporus* (*Melanopus*) *squamosus* from France. Falcoz (1921) reared it from *Hypholoma fasciculare*, from Vienne, Dauphiné, France.

The female has not put eggs on my breeding jars, perhaps because the type of fermentation in mine, with ample ventilation and much sawdust, is not attractive. I have only reared the fly once, from *Boletus* sp., from Gerrards Cross; several individuals emerged, also considerable numbers of *Helomyza variegata, Drosophila phalerata,*

Allocostylus diaphanus Wied.—A number of adults emerged in May, 1955, from *Boletus luridus* collected on Stoke Common, Bucks., 3rd October, 1954, also reared from *Pholiota squarrosa*, collected 1st November, 1954, in Gerrards Cross, adults emerging in mid-April.

Phaonia variegata Mg.—Dufour (1839) found a pupa in sand on which a mass of fungus had been lying for some months. Keilin (1917) found larvae in slightly decomposed *Boletus edulis* coming from the forest of Fontainbleu, France. The larvae of *P. variegata* were consuming those of *Pegomyia winthemi*; when the supply of prey was exhausted he reared his *P. variegata* on *Pegomyia transversa* Fall. from *Armillaria mellea*. Keilin also found that *P. variegata* might go through its larval life in rotten wood.

Séguy (1923) states that the insect may be reared from decomposing vegetable matter: he has found larvae in May in rotten fungi with larvae of *Pegomyia rufina*. Bonnamour (1929) records rearing it from *Tricholoma pessundatum*. Muirhead Thomson (1937), during his work in Ayrshire, Scotland, observed this insect during three years. He observed oviposition on the upper surface of a pileus of *Polyporus* growing beside a beech stump at the end of September. Oviposition was recorded once on a rotting *Polyporus*, on dead leaves on it, or on damp moss close to the fungus. He never saw the eggs on any other fungus, or elsewhere. The eggs were laid singly or in small groups, and the total per fly was not great. After about 9 days (at 10°C.) the larva, which is already in the third instar, emerged from the egg. It was carnivorous, feeding on the abundant larvae of *Mycetophila ornata* in the fungus: it did not prey on *Fannia* larvae and did not find those of *Trichocera* attractive. The larva of *P. variegata* was full-grown in less than two weeks, and wintered as a larva, pupating in January or February, the adults emerging at the end of March or April. *Phaonia* spp. have predatory larvae: he collected some information on larval biology of eleven species, of which four were certainly and others probably carnivorous.

Reared from *Pleurotus cornucopiae*, and *Clitocybe nebularis*, from Gerrards Cross.

P. goberti Mik.—Larvae found by Keilin under the bark of poplar logs near Paris were shown to be predatory on those of *Heteroneura*. Reared from *Polyporus hispidus*, near Vienne, Dauphiné, France (Falcoz, 1921).

Fannia ciliata Stein.—Recorded by Dufour from rotten *Boletus edulis*. Half a dozen *F. ciliata* emerged within a few weeks from a *Boletus (subtomentosus?)* collected in August, the material also produced *Leptocera* and *Metalimnobia*. From Tonbridge.

F. canicularis L.—Breeds in a great variety of decomposing vegetable materials and may be reared from fungi. Falcoz (1921) reared it from *Hypholoma fasciculare*, in France. I have reared it from POLYPORACEAE, *Polyporus dryadeus, P. adustus, Fistulina hepatica*, BOLETACEAE, *Boletus* sp., AGARICACEAE *Lactarius piperatus*, once each; from Gerrards Cross and Tonbridge.

F. monilis Hal.—Reared from *Pleurotus cornucopiae* (14/1) and *Polyporus squamosus* (11/1); from Gerrards Cross.

Piezura pardalina Rond.—One emerged from *Coprinus micaceus*, Gerrards Cross.

Mydaea tincta Zett.—Keilin was informed by Edwards that he had reared this insect from larvae in a *Russula* where they were preying on larvae of *Mycetophila*. It was recorded by Riel (1920) in France from *Russula nigricans*. I have reared it from three Agarics, on one occasion from each, *Pleurotus cornucopiae, Amanitopsis fulva* and *Russula ochroleuca*: from Gerrards Cross.

M. urbana Mg.—Common and breeds frequently in cow dung. The larvae is coprophagous in the second instar, an active and obligate carnivore in the third (Muirhead Thomson, 1937). One reared from *Polyporus squamosus*, from Gerrards Cross, collected in July. From the same collection I also reared *Metalimnobia bifasciata, Ula sylvatica, Drosophila phalerata* and *D. vibrissina, Mycetophila* sp., *Fannia monilis* and *Megaselia buxtoni*.

M. spinipes Karl.—Reared once only, several specimens (in British Museum) from *Polyporus squamosus*, from Gerrards Cross; collected in May, flies emerging at the end of June. The fungus contained hundreds of larvae of *Mycetophila cingulum* and *lineola*, also larvae of *Drosophila, Ula, Helomyza* and *Platypeza furcata*.

Hylemyia (Delia) albula Fall.—A score reared from the Agaric *Psilocybe ammophila*, growing among marram grass on a sand dune, Newborough Warren, Anglesey: collected July 15th, reared early August.

H. (D.) antiqua Mg.—Recorded by Bonnamour (1926) as reared from a number of Agarics, in France. The 'Onion fly' is 'a well known pest of onions, leeks and shallots' (Miles 1953), but not known to breed in other plants. The identification should be accepted with hesitation until confirmed.

H. (Pegohylemyia) cinerea Fall.—Reared from the Agarics *Amanita* sp. and *Hygrophorus virgineus*, from Gerrards Cross and from Sevenoaks, Kent.

Pegomyia ulmaria Rond.—Reared twice, several flies each time, from *Boletus* sp. and *Pholiota aegerita*, from Gerrards Cross.

P. winthemi Mg.—The few available facts suggest that this insect feeds only on species of *Boletus*. Keilin refers to these larvae being devoured by those of *Phaonia variegata* in *Boletus edulis*. The fly was reared in France by Riel (1920) from two species of *Boletus*. I have reared *P. winthemi* from *Boletus badius* and *versipellis*, numbers of flies, from a single collection in each case; from Gerrards Cross and Whipsnade.

P. transversa Fall.—Larvae in *Armillaria mellea* at Fontainebleau, France (Keilin, 1917).

P. iniqua Stein.—Reared from *Psalliota (Agaricus) angusta* in France (Bonnamour, 1926). Mrs. M. Miles informs me that she has bred this insect 'from a seemingly healthy *Agaricus* which decomposed only after the larvae reached maturity', from Wye, Kent. The mushroom was collected in September, the flies emerging at the end of April and in early May.

P. rufina Fall.—From *Psalliota (Agaricus) flavescens* collected in France in October, a number of these flies emerged from January to May (Bonnamour, 1920).

Anthomyia pluvialis L.—Reared from *Phallus impudicus* in France (Bonnamour, 1926).

DISCUSSION

Dufour (1839) set down a number of biological generalizations relating to those Diptera the larvae of which are found in fungi. His general conclusions, which still hold good, are that one species of fungus may be attacked at one and the same time by larvae of Diptera belonging to several families: that one may find the larvae of a single species of fly in several fungi, even unrelated ones: that there is a seasonal effect, for a particular fungus may harbour a succession of larvae in different months. One might perhaps say that, since Dufour's time, our knowledge of these numerous Diptera has only advanced in regard to certain families, particularly the Mycetophilidae. It might indeed be claimed that this paper is the first to give a general view, based on a wide collection of fungi and on the identification of nearly all the Diptera bred from them, and also on a consideration not only of breeding records but also of negative evidence.

COMMENTARY BASED ON THE FUNGI

The material must be considered botanically and entomologically. A rather crude classification of the fungi, condensed from the Appendix, is given as Table 1. The table shows what proportion of particular families or orders of fungi have been found to contain Diptera: in the Polyporaceae and Agaricaceae it is close to 50 per cent., it is less in the Tremellales, and considerably less (20 or 25 per cent.) in the Thelephoraceae and Clavariaceae. The Appendix gives the same type of information in a more extended form. It is evident that there are certain species and genera of fungi which have been collected repeatedly and almost always found to be infested with Diptera: others have seldom or never been found infested, even if a considerable number of collections have been examined. Clearly then, we have here a problem for further consideration.

Fungi with many associated insects.

If we consider the distribution of families and genera of Diptera among the fungi, it would seem best to select first a few examples of single collections which yielded relatively rich insect faunas:

(1) From mature but not decomposed *Polyporus giganteus* collected September 14th, Gerrards Cross:—*Mycetophila ornata* and *Drosophila funebris*, (emerged by end of September, note rapidity), *Ula sylvatica* (October 20th onwards), *Megaselia* sp., *Trichocera hiemalis* (December), *Tephrochlamys tarsalis* (March).

(2) From mature not decomposed *Hebeloma crustuliniforme*, collected December 7th at Chobham, Surrey:—*Mycetophila fungorum, M. lineola, Allodia lugens, A. ornaticollis* (all emerging December or January); *Helomyza bicolor* (in May). It is unusual to rear four species of Mycetophilidae from one collection. The fact that one may do so emphasizes that it is not wise to identify larvae by reference to reared adults, except in those cases (few at present) where one has good reason for believing that only one Mycetophilid feeds in a certain fungus.

(3) From several mature but not decomposed *Pleurotus cornucopiae*, collected August 2nd, on an elm log, Gerrards Cross, there emerged in mid August and early September: *Metalimnobia bifasciata, Ula sylvatica, Mydaea tincta, Calicoides scoticus, Leptocera* sp., *Megaselia giraudii*; and in October, *Phaonia variegata*. In contrast, from immature fruiting bodies (under 1 inch) of the same fungus collected on August 2nd, nothing emerged: from immature fruiting bodies, about 1½ inches across, I reared *Megaselia giraudii* and *Leucophenga maculata*.

Records given above relate to single collections. One might proceed to make a general list of the insects reared from some species of fungus,

bringing together material from several collections. But in the material under study there are few species of fungus collected frequently enough to permit this. We may, however, attempt to make such general lists for one member of the Polyporaceae, (*Polyporus squamosus*), and two of the Agaricaceae (*Russula ochroleuca* and *Pleurotus cornucopiae*), all of them supporting a rich and varied fauna of Diptera. The three lists are as follows:-

(1) From seven collections of *Polyporus squamosus* from Gerrards Cross I reared:—*Metalimnobia bifasciata, Ula sylvatica, Lestodiplosis* (*Coprodiplosis*) sp. near *polypori, Megaselia buxtoni, Leucophenga maculata, Drosophila vibrissima, D. phalerata, Helomyza variegata, Mydaea pagana, M. urbana, M. spinipes* and *Fannia monilis*. One collection from Tonbridge, in the month of May, produced several of the above, also *Bradysia?* sp., *Scatopse fuscipes*, and *Platypeza furcata*. Including the latter there are 15 species, of 9 families.

(2) From four collections of *Russula ochroleuca* (collected in Gerrards Cross in June, September, October and November), I reared:—*Metalimnobia bifasciata, Ula sylvatica, Culicoides scoticus, Forcipomyia ciliata, Sciophila lutea, Cordyla nitidula, Mycetophila luctuosa, Megaselia pygmaeoides, M. lutea, M. scutellariformis, Limosina parapusio, Mydaea tincta*. A total of twelve species, of six families.

(3) From three collections of *Pleurotus cornucopiae*, gathered in June and July at Gerrards Cross, the following insects were reared:— *Metalimnobia bifasciata, Ula sylvatica, Culicoides scoticus, Lestodiplosis* (*Coprodiplosis*) sp., *Brachypeza radiata, Medeterus apicalis, Megaselia giraudii, M. imberbis, M. buxtoni, Drosophila phalerata, D. vibrissina, Leucophenga maculata, Limosina* sp., *Leiomyza laevigata, Mydaea tincta, Phaonia variegata, Fannia monilis, Muscina stabulans*. A total of 18 species of 11 families.

What is striking about these three lists is surely their similarity. It is evident that many species of Diptera can be reared from soft Agarics and also the soft Polypore, though it is indeed true that there are species of flies and larger groups associated with one or very few species of fungi.

For the sake of comparison it is perhaps of interest to select three species of fungi which have yielded smaller insect faunas:-

(1) From eight collections of the Discomycete *Peziza* (*Aleuria*) *repanda* made in summer and autumn at Gerrards Cross:—*Allodia silvatica* (several times), *A. triangularis* (once), *Drosophila transversa, Megaselia flava, Helomyza variegata*.

(2) From four collections of *Pleurotus ostreatus* (October to December, Gerrards Cross and Windsor, Berkshire), I reared:—*Mycetophila ornata* (large numbers), *Trichocera hiemalis, Anisopus cinctus*. The contrast between the three species reared from *P. ostreatus* in autumn, and the 18 reared from the closely related *P. cornucopiae* in June and July (see above) is interesting. It seems possible that *P. ostreatus*, which generally produces its fruiting bodies rather late in the year, has for that reason a more limited fauna.

(3) From ten collections of *Coprinus micaceus* (in the broad sense), made at Gerrards Cross from April to September I obtained only:—Mycetophilid larvae in numbers, (nothing emerged), *Megaselia giraudii, Drosophila transversa, D. phalerata, Helomyza bicolor, Tephrochlamys tarsalis*. One collection of *C. micaceus* from Tonbridge added *Megaselia pygmaeoides*.

Fungi which appear 'unattractive' to insects.

Fungi seldom or never producing Diptera we call 'unattractive'. The Appendix shows that a diversity of species of different families fall in this group. Records of species of which a considerable number of collections have been made are presented in Table 3, which relates only to material collected in or about Gerrards Cross. This table shows that when Diptera are present in these unattractive fungi, the insects belong to few families; species of fly, however, exhibit a wide choice of food. One observes, for instance, that a characteristic species of *Mycetophila* is *ocellus;* one notes also *Helomyza* sp. and *Bradysia* sp. But though the majority of the Diptera are polyphagous, two or three of the Mycetophilids shown in Table 3 are restricted, so far as we know, to one or two food plants, e.g. *Trichonta vernalis, Phronia sinuata* and *Sciophila buxtoni*.

Further study of Table 3 reveals several tentative conclusions, e.g.:

(1) Some of these unattractive fungi are hard and dry. For instance the fruiting body of *Polyporus betulinus*, even when fresh, is tough and pithy. I have bred no Diptera from 6 collections, and have sliced up many others, but never found early stages of Diptera, though one or two insects are recorded from it by other entomologists. With it one may contrast *Polyporus squamosus* (above) from a few collections of which 15 species of Diptera appertaining to 9 families were reared. To the human being the essential difference between these two fungi appears to be in consistency: for *betulinus* is tough and resistant, but *squamosus* is soft and decomposes rapidly. This possible explanation receives some support from the Appendix, which shows that in Polyporaceae in general the proportion infected is low, the majority of these plants, except *P. squamosus, hispidus* and one or two others, being hard and tough.

Table 3 includes also a number of other hard, dry organisms, for instance the two Pyrenomycetes (*Xylaria* spp.), the three species of *Stereum*, the Agaric *Schizophyllum commune*, the 'ozonium' of *Coprinus* and the Gasteromycete *Lycoperdon pyriforme*. Among these *S. commune* is particularly interesting, for it is the only Agaric in my collections which is tough and dry; consistently no Diptera are reared from it; there is further information from 1954 and 1955 confirming this. The possibility that the absence of flies from *S. commune* may be due in part to season is discussed below. One may conclude that hardness appears to be one of the qualities which reduces the number and variety of Diptera attacking certain kinds of fungus. But it is to be observed that many of the plants shown in Table 3, for instance *Auricularia, Clavaria* and the small Agarics, are soft and liable to rapid decomposition: in spite of that, they are unattractive. In classifying a fungus as 'hard and dry' some caution must be used, for most of the plants mentioned above (*Stereum, Xylaria*, etc.) die and dry up without evident decomposition, so that there is some risk of collecting them after they are dead: whereas this cannot occur with a soft plant such as *P. squamosus* because it decomposes rapidly. It is important to guard against an error arising from this difference.

(2) There is a group of small Agarics of which the insect fauna is restricted and in which Diptera tend to be rare. The first six Agaric species shown in Table 3, i.e. down to and including *Psathyrella pygmaea*, are examples; there are others in the Appendix, for instance *Mycena* spp. All these are small, the cap less than ½ inch in diameter in average specimens and sometimes much less, and all of them come up singly (with the exception of *P. pygmaea* which grows in dense clumps). It might, therefore, be very difficult for a fly larva, after consuming one of these little toadstools to find another. The proportion infested with Diptera in the collections shown in the table is 9 out of 28, i.e. one third, with which one would compare approximately 50 per cent. (Table 1) for Agarics in general. Moreover the Dipterous fauna is limited, few species being recorded: with this, compare the lists of Diptera from the larger Agarics *Hebeloma crustuliniforme, Pleurotus cornucopiae, Russula ochroleuca* and even *Coprinus micaceus* (above). One cannot attribute the fauna of these small Agarics to insufficient material. They generally come up in abundance and most of my collections have consisted of 50—200 fruiting bodies, so that the total amount of material is comparable to what one might collect from some larger Agaric.

(3) Table 3 also suggests that the season of the year may have an important effect in determining whether Diptera will be found in a particular species of fungus. For instance, one collection of *Polyporus adustus* made in May contained Diptera of 4 species, whereas 7 collections made in November or December either contained nothing or (in two cases) single species. Also the collection of *Lycoperdon pyriforme* made in August yielded

4 species of Diptera, but seven collections made from September to November (and several dozens sliced up at the same period) showed no sign of Dipterous larvae). The absence of Diptera from the dry Agaric *Schizophyllum commune* may be due in part to its texture, but in part to the fact that it is found in winter.

There are singularly few records of Diptera from edible mushrooms, i.e. wild and cultivated members of the genus *Psaliota* (*Agaricus*). As to cultivated mushrooms, best referred to as *Psaliota hortensis*, the paper by Brauns (1950) is of considerable value; see also Thomas (1942), Austin (1933), Austin and Jary (1934). Both in the Old World and the New, cultivated mushrooms are attacked by Sciarines, Phorids and Cecidomyids, to which Austin adds *Drosophila funebris*. The absence of Mycetophilids (except the Sciarines) is remarkable, having regard to their abundance in Agarics. There are extremely few records of Diptera from wild species of *Psaliota*: if entomologists have studied them, they have not recorded the negative evidence.

COMMENTARY BASED ON THE INSECTS

If we now view our material as entomologists, we can consider first the distribution of Diptera among fungi, and the degree of specialization shown in choice of food plant, and then a number of other biological observations.

Association of species of Diptera with fungi.

It is evident from the records of breeding given above that the association of fly with fungus may be very general or specific to various degrees. Tentatively it is suggested that one might distinguish four categories, representing an increasingly close nexus between insect and plant. The categories might be defined as follows:-

(1) *Species reared from fungi: larvae probably eating fungi, but feeding also on decomposing vegetable material of other sorts.*

Examples:—*Trichocera hiemalis* and spp., *Forcipomyia ciliata, Scatopse fuscipes, Scenopinus fenestralis, Megaselia giraudii, M. rufipes, Drosophila funebris, Muscina stabulans* and *Fannia canicularis.*

It may be remarked that in decomposing vegetable material of any type, it is possible that the fly larvae confine themselves to eating mycelium, or moulds, or fungus material of some sort.

(2) *Insects reared from fungi only, but from a wide range of families.*

A number of examples are given in Table 4. It will be noted that nearly all these insects occur in Agaricaceae and many of them also in Polyporaceae: beyond that, the choice of families of fungi is curiously different for different insects. Further work may show that many of the insects shown in this table breed in a still wider range of fungi.

(3) *Insects which are reared only from fungi and which appear to be limited to a particular family.*

For example:—Polyporaceae, *Ditomyia fasciata* (hard Polypores only), *Dynatosoma fuscicorne*; Agaricaceae, *Allodia ornaticollis*; Boletaceae, *Pegomyia winthemi.*

(4) *Insects which have been reared only from fungi and are perhaps confined to one species or to a few related species.*

Pyrenomycetes, *Daldinia concentrica, Amiota alboguttata;* Discomycetes, *Peziza* (*Aleuria*) *repanda, Allodia silvatica;* Tremellales, *Calocera viscosa, Phronia sinuata;* Polyporaceae, *Trametes* spp., *Sciophila buxtoni;* Polyporaceae, *Poria versipora, Trichonta vitta;* Polyporaceae, *Polyporus squamosus, Mycetophila cingulum;* Agaricaceae, *Hypholoma fasciculare, Bolitophila saundersi* (one record, *Tricholoma*); Agaricaceae, *Hypholoma sublateritium, Bolitophila cinerea* (one record, *Hypholoma velutinum*); Agaricaceae, *Paxillus involutus, Bolitophila hybrida* (also from *Boletus*); Agaricaceae, *Russula* spp., *Cordyla nitidula.*

Other biological notes.

I seldom disturbed the material in my breeding jars, so that little information has been gathered as to which larva may be predacious or vegetarian: or whether a vegetarian larva attacks undamaged tissues or those in which some other insect has already made tunnels: or whether it eats the gills, or the solid tissues of the cap or of the stem. The following points of general interest have, however, presented themselves. Other biological notes will be found in the text, particularly in the systematic list of insects reared.

(1) *Seasonal cycles.*

Many Diptera of a number of families emerge from the pupa in April or May, though few of the fungi are producing fruiting bodies at that season. For instance, among the Agarics, St. George's mushroom (*Tricholoma gambosum*) is traditionally associated with the saint's day, April 23rd, and a few other Agarics appear in the spring or early summer: they are, however, irregular in appearance and seldom common. During the same season, there are few fresh fruiting bodies of Polyporaceae, except that *Polyporus squamosus* is abundant. The Pyrenomycete *Hypoxylon deustum* (*Ustulina vulgaris*) is common, and is a food plant of a number of flies. *Stereum** and many other fungi are not available at all. The number of fruiting bodies and the variety of species is quite inadequate for the numerous Diptera on the wing in spring and early summer. Flies emerging in April and May probably live for a long period, in a state of sexual immaturity, until they can avail themselves of the abundance and variety of fungi appearing in late summer and early autumn. If this is the case, the annual cycle must depend on an elaborate type of adult diapause, and the number of generations of the insect may be very low, even one only. Assuming this to be correct, there is a remarkable contrast between the longevity of the adult fly and the extremely rapid development of the early stages in the short lived fruiting body.

*Dead fruiting bodies of *Stereum, Xylaria* and woody Polypores are persistent and may be found. They produce no Diptera in my experience.

(2) *Possible importance of mycelium.*

Though it appears likely that the adult flies, or at least the females which emerge in the spring, must live some months until fungi are available for egg-laying, there is another possibility to be considered. As we have seen above, the mycelium is generally more bulky and longer lived than the fruiting bodies or sporophore. It is possible that larvae of flies which have reared from sporophores are capable of feeding also on the mycelium, either in the soil or in rotten wood. This is true of cultivated mushrooms, *Psaliota hortensis*, for it is recorded that a Cecidomyid, *Mycophila speyeri*, feeds on the mycelium in the mushroom bed (Anderson, 1936). Moreover, Thomas, (1942) writing of mushroom culture in North America, states definitely that the mycelium is attacked not only by that Cecidomyid, but also by larvae of Phorids (*Megaselia*) and Sciarines. Thus there is reason for thinking that in nature the mycelia of a variety of fungi may be more important as food material than we have supposed. It will not be easy to confirm this, but one might endeavour to rear insects from the soil immediately under a clump of Agarics., for comparison with other samples from spots a few feet away. One could also investigate the soil immediately in and around 'fairy rings' which must no doubt be full of the perennial mycelium of *Marasmius oreades* or of one of the other fungi with a similar habit. I have already given some little attention to the 'ozonium' of *Coprinus*. This is a mass of sterile tissue growing on the surface of dead wood: it cannot, however, be said that my efforts have been rewarded, for out of 17 samples of this 'ozonium' two only produced Diptera (Table 3). Another type of sterile perennial fungal tissue which could be obtained in fair quantity, is the rhizomorphs of *Armillaria mellea.*

(3) *Enemies of larvae.*

Little is known of the enemies of Dipterous larvae in fungi. In any suburban garden toadstools may often be seen torn and broken into pieces. I expect that this is done by thrushes and blackbirds (*Turdus*) searching for Dipterous larvae. The growths of *Stereum* are also often destroyed,

and from the tooth marks I think that this is probably done by grey squirrels (the introduced *Sciurus carolinensis*). They are eating the fungus, not searching for larvae: whatever may be the explanation, large quantities of *Stereum* disappear early in the winter.

(4) *Parasitic insects.*

The study of the insects which parasitize the Dipterous larvae in fungi will be greatly facilitated when methods have been brought into use for isolating single larvae or cocoons. It has been shown by Séguy (1940) that certain Proctotrupids and Braconids are parasitic on particular genera of Mycetophilids, and a useful list was given by Madwar (1937:93) of organisms found as parasites in Mycetophilid larvae. He records four Proctotrupids, one Braconid and ten Ichneumonids: also Nematodes and Protozoa. Madwar himself, and others quoted by him, have bred the Ichneumonid *Proclitus edwardsi* Roman from the larva of the Mycetophilid *Brachypeza radiata* Jenk. The parasite may be common, and as suggested by Edwards a high degree of parasitism might account for the scarcity of adults of the fly though the larvae are abundant. An unusual observation was recorded by Thompson (1938), who examined larvae, probably of the genus *Sciara*, collected near Paris. In one of these he found a first instar larva the structure of which suggests that it may be that of an unknown Acalyptrate. As Thompson remarks, if this parasitic fly normally develops in *Sciara*, the adult must be very small. No corresponding insect has emerged from my numerous collections containing numbers of *Sciara*. As Thompson points out, it is rare for a larva of a Dipteron to be parasitized by another Dipteron.

(5) *Fungivorous Nematodes.*

In breeding jars, in which fungi are decomposing, one may frequently observe creamy streaks in the water of condensation on the inside of the jar. These consist of great numbers of immature Nematodes, of several genera. Among them the late Tom Goodey rediscovered *Iotonchium* (*Tylenchus*) *fungorum*, which was described by Bütschli in 1873 and had not been seen since: it is an organism of great interest to specialists (Goodey, 1953).

SUMMARY

(1) The basis of the paper is the Diptera of all families bred from 447 collections of 154 species of fungi in the period 1950—1953 (Table 1 and Appendix). A 'collection' means one or more fungi of a single species collected at one time and place. Almost all the material was from south-east England. The paper also includes published records of Diptera reared from fungi from Britain, continental Europe and America.

(2) The Diptera reared belong to 98 species of 16 families (Table 2). In addition, five flies are referred to in the text, reared from fungi collected in 1954, and 10 further species may be added which have been reared from fungi in Britain as has been known from published records. This, however, in no way makes a complete record of British Diptera known to have been reared from fungi.

(3) As to the fungi, I have sought material widely among the larger forms and reared Diptera, or attempted to do so, from many species of fungi which are common enough, but have never before been examined by entomologists. Partly for that reason the paper contains records of quite a number of flies which have been reared once or more from particular species of fungi, no previous records of the food plant being available. Lists are given showing the considerable number of species of Diptera which may be reared even from one collection of a favourable type of fungus. If one brings together the information derived from a number of collections, one may make a total list of between ten to nearly twenty species of Diptera of as many as eleven families reared from a single fungus species (page 86). All the fungi which support large Dipterous faunas are soft and decompose rather rapidly. Some are Agarics but certain soft Polypores (e.g. *Polyporus squamosus*) produce a great variety of insects.

(4) A number of species of fungi of different families support few Diptera or even none, even though a considerable number of collections of the fungus have been made. When Diptera occur in these plants they tend to be of species exhibiting a wide choice of food plant and to belong to few families. It seems that a fungus may be relatively 'unattractive' for one of several reasons. Fungi which are hard, dry and tough form one group; it is significant that species of unattractive fungi belonging to several families

share this characteristic. Another group consists of small Agarics which though soft and fleshy are seldom infested with larvae of flies, perhaps because they are so small and provide insufficient food. There is also a suggestion that sporophores which become mature very late in autumn or in winter may contain no Diptera or almost none: in a few instances I have shown that within one species of fungus the winter sporophores may be without Diptera whereas those found in summer may support several species (page 63, Table 3).

(5) The degree of association between the fly and fungus may be very general or specific to different degrees (pages 85-86). Some of the Diptera may also be reared from decomposing vegetable material of other sorts. Other Diptera appear to be associated invariably with fungi, but of a wide range of families (Table 4). Others again have been reared repeatedly from fungi within one family only, or are even more specific and associated with a single species of fungus, or two or three related species.

(6) Adults of many of these Diptera are known to emerge in the spring, a season at which fungi of almost all families are exceedingly scarce or non-existent. It may be that some of these adults live some months until sporophores become available in the late summer and autumn, but others possibly feed upon the appropriate mycelium either in the soil or in rotten wood. The mycelium, except that of cultivated mushrooms, is a food material which has not yet been studied. It is suggested that there are several types of unexplored types of food material and it is certain that there are a large number of Diptera (particularly among the Mycetophilidae) which must be assumed to be fungus eaters, but which have never been reared in spite of the considerable amount of work which has been devoted to the subject.

APPENDIX

List of fungi examined.

This appendix gives a list of all fungi examined, to the end of 1953, arranged systematically. The first number gives the number of collections examined; the second number, the collections in which Dipterous larvae were observed. In many cases larvae were seen, but no adults bred, so that the list does not agree in all respects with the text of the paper, which is based on adult Diptera bred and identified. All were from South-East England, the great majority from Gerrards Cross, Bucks.

MYXOMYCETALES

(See Buxton, 1954.)

ASCOMYCETES

Pyrenomycetes

Nectria cinnabarina (Tode ex Fr.) Fr., 3, 0; *Daldinia concentrica* (Bolt. ex Fr.) Ces. and de Not., 2, 0; *Hypoxylon fragiforme* (Pers. ex Fr.) Kickx., (= *H. coccineum* Bull.), 3, 1; *H. deustum* (Hoffm. ex Fr.) Grev., (= *Ustulina vulgaris* Tul.), 3, 2; *Xylaria hypoxylon* (L. ex Fr.) Grev., 8, 2; *X. polymorpha* (Pers. ex Fr.) Grev., 9, 2.

Discomycetes

Coryne sarcoides (Jacq. ex Fr.) Tul., 3, 0; *Orbilia leucostigma* Fr., 2.0; *Peziza* (*Aleuria*) *micropus* Pers. ex Fr., 1,1; *Peziza* (*Aleuria*) *reparda* Pers. ex Fr., 8, 7; *Bulgaria inquinans* [Pers.] Fr., 2, 1; *Aleuria aurantia* (Pers. ex Fr.) Fuckel, 1, 0.

BASIDIOMYCETES

TREMELLALES

Auricularia auricula-judae (Fr.) Schröet, 11, 6; *A. mesenterica* Fr., 10, 2; *Calocera cornea* (Fr.) Loudon, 5, 4; *C. viscosa* (Pers. ex Fr.) Fr., 6, 1; *Dacrymyces deliquescens* (Bull. ex Mérat) Duby, 3, 0.

APHYLLOPHORALES

Thelephoraceae

Stereum hirsutum (Willd. ex Fr.) Fr., 7, 1; *S. purpureum* (Fr.) Fr., 7,3; *S. gausapatum* Fr., 7, 0; *Corticium laeve* (Pers.) Quél., 7, 1; *C.* ? sp., 1, 1; *C.* (*Gloeocystidium*) *lactescens* Berk., 1, 1; *Peniophora setigera* (Fr.) Bres., 1, 0; *P. gigantea* (Fr.) Massee, 1, 0; *P. quercina* (Pers. ex Fr.) Cooke, 1, 0; *Phlebia radiata* Fr., 1, 1; *Coniophora puteana* (Schum. ex Fr.) Karst., 2, 1.

Clavariaceae

Clavaria corniculata Schaeff. Fr., 1, 0; *C. stricta* Pers. ex Fr., 1, 0; *C. vermicularis* Fr., 1, 1; *C. fumosa* Pers. ex Fr., 1, 0; *C. inaequalis* Müller ex Fr., 4, 1; *C. argillacea* Pers. ex Fr., 1, 0; *C. rugosa* Bull. ex Fr., 1, 0.

Polyporaceae

Polyporus squamosus [Huds.] Fr., 11, 10; *P. giganteus* [Pers.] Fr., 4, 3; *P. frondosus* [Dicks.] Fr., 2, 0; *P. sulphureus* [Bull.] Fr., 2, 1; *P. betulinus* [Bull.] Fr., 7, 0; *P. hispidus* [Bull.] Fr., 2, 1; *P. dryadeus* [Pers.] Fr., 5, 2; *P. adustus* [Willd.] Fr., 8, 3; *P. fissilis* Berk. & Curt., 2, 2; *P. picipes* Fr., 3, 1; *P. fumosus* [Pers.] Fr., 1, 1; *P.* ? sp., 1, 0; *Fomes annosus* (Fr.) Cooke, 4, 1; *F. ulmarius* ([Sow.]Fr.) Sacc., 9, 4; *F. pomaceus* (Pers.) B. and G., 3, 0; *Polystictus versicolor* ([L.]Fr.) Sacc., 16, 6; *Trametes confragosa* ([Bolt.]Fr.) Jörstad (= *rubescens* Fr.), 6, 2; *T. gibbosa* ([Pers.]Fr.) Fr., 5, 4; *Daedalia quercina* [L.] Fr., 6, 2; *D. biennis* [Bull.] Fr., 2, 2; *Lenzites betulina* ([L.] Fr., 1, 0; *Poria versipora* (Pers.) Baxter (= *mucida* ([Pers.] Fr.) Bres.), 2, 2; *P.* ? sp., 1, 0; *Fistulina hepatica* (Huds.) Fr., 5, 3; *Merulius corium* Fr., 1, 0.

AGARICALES

Boletaceae

Boletus luridus Schaeff. ex Fr., 2,0; *B. subtomentosus* Fr. (= *Xerocomus subtomentosus* (Fr.) Quél.), 2, 1; *B. badius* Fr., 1, 1; *B. versipellis* Fr. (= *Leccinium versipelle* (Fr.) Snell), 3, 3; *B.* ? sp., 4, 1.

Agaricaceae

Amanita phalloides (Vail. ex Fr.) Secr., 1, 1; *A. muscaria* (Linn. ex Fr.) Hooker, 3, 5; *A. rubescens* (Pers. ex Fr.) S. F. Gray, 1, 0; *A.* ? sp., 1,1; *Amanitopsis fulva* (Secr.) W. G. Smith, 1, 1; *Lepiota cristata* (A. & S. ex Fr.) Kummer, 1, 1; *Armillaria mellea* (Vahl. ex Fr.) Kummer, 3, 2; *Tricholoma rutilans* (Schaeff. ex Fr.) Kummer, 1, 1; *T. atrocinereum* (Pers. ex Fr.) Quél. sensu Bresadola, 2, 2; *T. gambosum* (Fr.) Kummer, 2, 2; *T. nudum* (Fr.) Kummer, 2, 2; *T. personatum* (Fr.) Kummer, 1, 0; *Clitocybe nebularis* (Batsch ex Fr.) Kummer, 1,1; *C. aurantiaca* ([Wulf.] Fr.) Studer = *Hygrophoropsis aurantiaca* ([Wulf.] Fr.) Maire, 1, 0; *C. geotropa* (Bull. ex Mérat) Quél., 3, 3; *C. cyathiformis* (Bull. ex Fr.) Kummer = *Cantharellula cyathiformis* (Bull. ex Fr.) Singer, 1,1; *C. vibecina* (Fr.) Quél., 2, 1; *Laccaria laccata* (Scop. ex Fr.) Cke., 1, 1; *Collybia radicata* (Rehl ex Fr.) Quél., 2, 1; *C. maculata* (A. & S. ex Fr.) Kummer, 1, 1; *C. velutipes* (Curt. ex Fr.) Kummer = *Flammulina velutipes* (Curt. ex Fr.) Karst., 6, 1; *Marasmius oreades* (Bolt. ex Fr.) Fr., 8, 5; *Mycena avenacea* (Fr.) Quél., 2, 1; *M. filopes* (Bull. ex Fr.) Kummer non Kühner, 1, 0; *M. flavo-alba* (Fr.) Quél., 5, 1; *M. olida* Bres., 2, 0; *M. galericulata* (Scop. ex Fr.) Kummer, 1, 1; *M. inclinata* (Fr.) Quél., 1, 1; *M.* ? sp., 3, 2; *Omphalia fibula* var *Swartzii* (Fr.) Karst = *Hemimycena Setipes* (Fr.) Singer, 4, 1; *Pleurotus corticatus* (Fr.) Kummer = *P. dryinus* (Pers. ex Fr.) Kummer, 1, 1; *P. cornucopiae* (Paulet ex Persoon) Gillet = *sapidus* Schulz., 14, 9; *P. ostreatus* (Jacq. ex Fr.) Kummer, 4, 4; *P. lignatilis* (Fr.) Kummer, 1, 0; *P. nidulans* (Pers.) Fr., 1, 0; *P. serotinus* (Schrad. ex Fr.) Kummer, 1, 1; *Panus stipticus* (Bull. ex Fr.) Fr., 1, 0; *Schizophyllum commune* Fr., 3, 0; *Hygrophorus niveus* [Scop.] Fr., 1, 0; *H. virgineus* Wulf. ex Fr., 4, 2; *H. coccineus* Schaeff. ex Fr., 1, 1; *H. puniceus* Fr., 1,0; *Lactarius vellereus* (Fr.) Fr., 1, 1; *L. piperatus* (Scop. ex Fr.) Fr., 1, 1; *L.* ? sp., 1, 0; *Russula nigricans* Fr., 1, 1; *R. ochroleuca* (Fr.) Fr., 6, 4; *R. luteotacta* Rea, 1, 1; *R. vinosa* Lindb., 1, 1; *R.* ? sp., 1, 1; *Volvaria* (*Volvariella*) *speciosa* (Fr.) Kummer, 1, 0; *Pluteus cervinus* (Schaeff. ex Secr.) Kummer, 1, 1; *P. umbrosus* (Pers. ex Fr.) Kummer, 1, 1; *Entoloma rhodopolium* (Fr.) Kummer, 2, 1; *Pholiota squarrosa* (Müll. ex Fr.) Kummer, 1, 1; *P. aegerita* (Brig.) Quél. = *Agrocybe cylindracea* (DC ex Fr.) R. Maire, 1, 1; *P. mutabilis* (Schaeff. ex Fr.) Kummer = *Kuehneromyces mutabilis* (Schaeff. ex Fr.) Singer & Smith, 1, 0; *P. marginata* (Batschr ex Secr.) Quél. = *Galerina marginata* (Batsch ex Secr.) Kühner, 1, 0; *Inocybe lacera* (Fr.) Kummer, 1, 0; *Hebeloma crustuliniforme* (Fr.) Quél., 1, 1; *Naucoria semiorbicularis* (Bull. ex Mérat) Quél., 1, 0; *Tubaria furfuracea* (Pers. ex Fr.) Gillet, 1, 0; *Galerina graminea* (Vel.) Kühner, 3, 0; *G. clavata* (Vel.). Kühner, 4, 2; *Bolbitius titubans* (Bull.) Fr. = *B. vitellinus* (Pers. ex Fr.) Fr., 1, 1; *Paxillus involutus* (Batsch ex Fr.) Fr., 1, 1; *Psaliota* ? sp., 1, 0; *Hypholoma sublateritum* (Fr.) Quél., 1, 1; *H. fasciculare* (Huds. ex Fr.) Kummer, 5, 4; *Anellaria separata* (Linn.) Karst = *semiorala* Sow, 1, 0; *Panaeolus fimicola* (Fr.) Quél. var. *ater* Lange, 1, 0; *P. papilionaceus* (Bull. ex Fr.) Quél., 1, 0; *Psathyrella subatomata* (Lange) Moser, 1, 0; *P. disseminata* (Pers. ex Fr.) Quél., 7, 3; *P. pygmaea* (Bull. ex Fr.) Singer sensu Quélet non Favre = *consimilis* Bres. & P. Henn., 7, 3; *P.* ? sp., 1, 1; *Coprinus comatus* (Fr.) S. F. Gray, 1, 0; *C. micaceus* (Bull. ex Fr.) Fr., 12, 9; *C. radians* (Desm.) Fr., 2, 1; *C.* 'ozonium' stage, 16, 2; *C.* ? sp., 3, 0.

GASTEROMYCETES

Phallus impudicus Pers., 1, 0; *Lycoperdon pyriforme* Pers., 9, 1 (and several dozen sliced up; negative); *Scleroderma cepa* Pers., 1, 1; *S. verrucosum* Pers., 1, 0.

FUNGI IMPERFECTI

Oidium sp., 1, 0; *Monilia fructigena* Pers. ex Westend., 1, 0; *Trichothecium roseum*

REFERENCES

Alexander, C. P., 1915, The biology of the North American crane flies (Tipulidae, Diptera). III. The genus *Ula* Haliday, *J. Ent. Zoo.* **7**:1-9; 1920, The crane flies of New York. Part II. Biology and phylogeny, *Mem. Cornell agric. Exp. Sta.* no. 38:699-1133. **Anderson, J. A. T.**, 1936, Gall-midges (Cecidomyidae) whose larvae attack fungi, *J. S.-E. agric. Coll. Wye*, **38**:95-107. **Audcent, H. L. F.**, 1949, Bristol insect fauna: Diptera., *Proc. Bristol Nat. Soc.* **27**:409-470. **Austin, M. D.**, 1933, The insect and allied fauna of cultivated mushrooms, *Ent. mon. Mag.* **69**:16-19. **Austin, M. D. & Jary, S. G.**, 1934, Investigations on the insect and allied pests of cultivated mushrooms: II & III, *J. S.-E. agric. Coll. Wye*, **34**:70-86.

Barendrecht, G., 1938, The Dutch Fungivoridae in the collection of the Zoological Museum at Amsterdam, *Tijdschr. Ent.* **81**:35-54. **Barnes, H. F.**, 1946, Gall midges of economic importance, **1**, Gall midges of root and vegetable crops, London. **Basden, E. B.**, 1953, The autumn flush of *Drosophila* (Diptera), *Nature, Lond.* **172**:1155-1156; 1954a, The distribution and biology of Drosophilidae (Diptera) in Scotland, including a new species of '*Drosophila*'. *Trans. roy. Soc. Edinb.* **62**:603-654; 1954b, Diapause in *Drosophila* (Diptera: Drosophilidae) *Proc. R. ent. Soc. Lond.* (A), **29**:114-18. **Bonnamour, S.**, 1926, Les insectes parasites des champignons. II Élevages et nouvelle liste de Diptères fongicoles, *Ann. Soc. linn. Lyon.* **72**:85-93. **Brauns, A.**, 1950, Zur Kenntnis der Schädinsekten an Champignon-kulturen, *NachrBl. dtsch. PflschDienst, Berl.* **2**:153-156. **Buxton, P. A.**, 1954, British Diptera associated with fungi. 2. Diptera bred from Myxomycetes, *Proc. R. ent. Soc. Lond.* (A), **29**:163-171. **Buxton, P. A. & Barnes, H. F.**, 1953, British Diptera associated with fungi. 1. Gall midges (Cecidomyidae) reared from the larger fungi, *Proc. R. ent. Soc. Lond.* (B) **22**:195-200.

Cheetham, C. A., 1920, A liverwort-eating larva, *Naturalist. Lond.* **1920**:190. **Coe, R. L.**, 1941, Some breeding records of British Tipulidae (Dipt.), *Ent. mon. Mag.* **77**:172; 1953, Diptera, Syrphidae, in R. ENT. SOC. LOND., *Handb. ident. Brit. ins.* **10**, (1), London. **Collin, J. E.**, 1941, The British species of the Dolichopodid genus *Medeterus* Fisch. (Dipt.), *Ent. mon. Mag.* **77**:141-153; 1943, The British species of Helomyzidae (Diptera), *Ent. mon. Mag.* **79**:234-251. **Colyer, C. N.**, 1952, Notes on *Triphleba minuta* F. (Dipt., Phoridae and its immature stages, *Ent. mon. Mag.* **88**:226-229; 1954, A new species of *Megaselia* (Dipt., Phoridae) from Britain: notes on British fungicolous Phoridae, *Ent. mon. Mag.* **90**:108-112. **Cuthbertson, A.**, 1926, Studies on Clyde crane-flies. Larval habits of some local species, *Ent. mon. Mag.* **62**:84-88. **Czerny, L.**, 1930, Clythiidae (Platypezidae), in LINDNER, E., *Flieg. Palaearkt. Reg.* **4** (34):1-29.

Degeer, C., 1776, Mémoires pour servir à l'histoire des insectes, **6**:361, Stockholm. **Downes, J. A. & Kettle, D. S.**, 1952, Descriptions of three species of *Culicoides* Latreille (Diptera: Ceratopogonidae) new to science, together with notes on, and a revised key to the British species of the *pulicaris* and *obsoletus* groups, *Proc. R. ent. Soc. Lond.* (B) **21**:61-78. **Dufour, L.**, 1839, Mémoire sur les métamorphoses de plusieurs larves fongivores appartenant à des Diptères, *Ann. Sci. nat.* **12** (Zool.):5-61; 1840, Seconde mémoire sur les métamorphoses de plusieurs larves fongivores appartenant a des Diptères, *Ann. Sci. nat.* **13** (Zool.):148-163; 1842, Histoire des métamorphoses du *Sciophila striata*, *Mém. Soc. Sci. Lille*, **1841**:201-208; 1853, Mélanges entomologiques. (Suite) (1), *Ann. Soc. ent. Fr.* (3) **1**:383-388.

Edwards, F. W., 1925, British fungus-gnats (Diptera, Mycetophilidae). With a revised generic classification of the family, *Trans. R. ent. Soc. Lond.* (**1924**):505-662; 1936, *Amiota alboguttata* Wahlb. in Dorset (Diptera, Drosophilidae), *Entomologist*, **69**:218; 1941, Notes on British fungus-gnats (Dipt., Mycetophilidae), *Ent. mon. Mag.* **77**:21-32, 67-82.

Falcoz, L., 1921, Notes sur divers Insectes fungicoles. *Misc. ent.* **25**:57-62; 1922, Notes biologiques sur divers insectes des environs de Vienne en Dauphiné, *Bull. Soc. ent. Fr.* **1922**:223-228; 1924, Observations biologiques sur divers Insectes des environs de Vienne en Dauphiné (3e note). *Bull. Soc. ent. Fr.* **1924**:221-224. **Foray Committee of the British Mycological Society**, 1952, *Guide to the literature for the identification of British fungi*, London. **Freeman, P.**, 1956, Two new species of Mycetophilidae (Diptera, Nematocera), *Proc. R. ent. Soc. Lond.* (B), **25**:26-28.

Goodey, T., 1953, On certain eelworms, including Bütschli's *Tylenchus fungorum*, obtained from toadstools, *J. Helminth.* **27**:81-94. **Goureau, C.**, 1852 [Observations sur les insectes qui vivent au dépens de la truffe], *Ann. Soc. ent. Fr.* (2), **10**:lxxv-vi.

Haliday, A. H., 1833, Catalogue of Diptera occurring about Holywood in Downshire, *Ent. Mag.* **1**:147-180. **Hawker, L. E.**, 1954, British hypogeous fungi, *Phil. Trans.* B, **237**:429-546; 1955, Hypogeous fungi, *Biol. Rev.*, **30**:127-158.

Johannsen, O. A., 1909-1912, The fungus gnats of North America Parts I-IV, *Bull. Me agric. exp. Sta.* nos. **172**:209-276; **180**:125-192; **196**:249-328; **200**:57-146.

Keilin, D., 1917, Recherches sur les Anthomyides à larves carnivores. *Parasitology*, **9**:325-450. **Kessel, E. L. & Kessel, B. B.**, 1939, Diptera associated with fungi, *Wasmann Collector*, **3**:73-92.

Laboulbène, A., (1864). Observations sur les insectes tubérivores. Avec refutation de l'erreur qui, attribuent les Truffes à la piqûre d'un Insecte, les a fait assimiler aux galles

végétales, *Ann. Soc. ent. Fr.* (4) **4**:69-114. **Landrock, K.**, 1926-27, Fungivoridae (Mycetophilidae), *in* LINDNER, E., *Flieg. Palaearkt.* Reg., **2**(1) 8:1-195.

Madwar, S., 1934a, The biology and morphology of *Bolitophila hybrida* Meigen (Diptera Nematocera). *Bull. Soc. ent. Egypte*, **17**:126-135; 1934b, The biology and morphology of *Pnyxia scabiei* Hopkins (Diptera: Nematocera), *Bull. Soc. ent. Egypte*, **17**: 136-149; 1935a, Biology and morphology of the immature stages of *Mycetophila marginata* Winnertz and *Dynatosoma fuscicorne* Mg., *Ann. Mag. nat. Hist.* (10), **15**:108-117; 1935b, The biology and morphology of the immature stages of *Macrocera anglica* Edwards, *Psyche, Camb., Mass.*, **42**:25-34; 1937, Biology and morphology of the immature stages of Mycetophilidae (Diptera, Nematocera), *Phil. Trans.*, (B), **227**:1-110. **Malloch, J. R.** 1917, A preliminary classification of Diptera, exclusive of Pupipara, based upon larval and pupal characters, with keys to imagines in certain families. Part I, *Bull. Ill. Lab. nat. Hist.* **12**:161-409. **Mansbridge, G. H. & Buxton, H. W.**, 1933, On the biology of some Ceroplatinae and Macrocerinae (Diptera, Mycetophilidae) with an appendix on the chemical nature of the web fluid in larvae of Ceroplatinae. *Trans. R. ent. Soc. Lond.* **81**:75-92. **Metz, C. W. & Moses, M. S.**, 1928, Observations on sex ratio determination in *Sciara* (Diptera). *Proc. nat. Acad. Sci., Wash.* **14**:930-932. **Metz, C. W. & Ullian, S. S.**, 1929, Genetic identification of the sex chromosomes in *Sciara* (Diptera). *Proc. nat. Acad. Sci., Wash.* **15**:82-85. **Miles, M.**, 1953, Studies of British Anthomyiid Flies. V. The onion fly, *Delia antiqua* (Mg.), *Bull. ent. Res.* **44**:583-588. **Ministry of Agriculture & Fisheries**, 1954, *Mushroom growing*, 6th ed., *Bulletin* No. 34, London: H. M. Stationery Office. **Muirhead Thomson, R. C.**, 1937, Observations on the biology and larvae of the Anthomyidae. *Parasitology*, **29**:273-358.

Perris, É., 1839. Notice sur quelques Diptères nouveaux, *Ann. Soc. ent. Fr.* **8**:47-57; 1849, Notes pour servir à l'histoire des métamorphoses de diverses espèces de diptères. (Deuxième partie), *Ann. Soc. ent. Fr.* (2) **7**:331-351.

Ramsbottom, J., 1923, *A handbook of the larger British fungi*. London. **Riel, P.**, 1921, Les insectes parasites des champignons. I. Élevages et première liste de Diptères fongicoles, *Ann. Soc. linn. Lyon*, **67**:37-44.

Satchell, G. H., 1947a, The larvae of the British species of *Psychoda* (Diptera: Psychodidae), *Parasitology*, **38**:51-69; 1947b, The ecology of the British species of *Psychoda* (Diptera: Psychodidae), *Ann. appl. Biol.* **34**:611-621. **Saunders, L. G.**, 1924, On the life history and the anatomy of the early stages of *Forcipomyia* (Diptera, Nemat., Ceratopogoninae), *Parasitology*, **16**:164-213. **Schmitz, H.**, 1948, Zur kenntnis der fungicolen Buckelfliegen (Phoridae, Diptera), *Natuurh. Maandbl.* **37**:37-44. **Séguy, E.**, 1923, *Faune de France*, **6** (Diptères Anthomyides), Paris; 1940, *Faune de France*, **36** (Diptères nématocères) (Fungivoridae, Lycoridae, Hesperinidae, Bibionidae, Scatopsidae, Phrynidae, Pachyneuridae, Blepharoceridae), Paris; 1951, Ordre des Diptères (Diptéras Linné, 1758) in GRASSÉ, P. P., *Traité de Zoologie*, **10** (1):449-744, Paris. **Spencer, W. P.**, 1942, New species in the *quinaria* group of the subgenus *Drosophila*, *Univ. Tex. Publ.*, no. 4213, 53-66.

Thomas, C. A., 1942, Mushroom insects: their biology and control. *Bull. Pa agric. Exp. Sta.*, no. 419. **Thompson, W. R.**, 1938, A Dipterous parasite of Mycetophilids, *Parasitology*, **30**:176-180. **Tollet, R.**, 1953, Élevage de *Bolitophila hybrida* Meigen. *Bull. (Ann.) Soc. ent. Belg.* **89**:270. **Townsend, C. H. T.**, 1893, A general summary of the known larval food-habits of the Acalyptrate Muscidae, *Canad. Ent.* **25**:10-16.

Verrall, G. H., 1901, *British flies*, **8**, (Platypezidae, Pipunculidae & Syrphidae of Great Britain), London; 1904, List of British Dolichopodidae, with tables and notes, *Ent. mon. Mag.* **40**:164-173; 1912, Another hundred new British species of Diptera, *Ent. mon. Mag.* **48**:20-27.

Wakefield, E. M. & Dennis, R. W. G., 1950, *Common British fungi*, London. **Wakely, S.**, 1953, *Amiota alboguttata* (Wahlb.) (Dipt., Drosophilidae) in Surrey, *Entomologist*, **86**:199. **Weiss, H. B. & West, E.**, (1920). Fungous insects and their hosts, *Proc. biol. Soc. Wash.* **33**:1-20. **Willard, F.**, 1914, Two new species of *Platypeza* found at Stanford University, *Psyche, Boston*, **21**:166-168.

London School of Hygiene and Tropical Medicine.

July 6th, 1956.

Hallodapus montandoni (*Reuter*) (*Hem.-Het. Miridae*) *in a new locality in Kent.*—On June 20th, 1959, I took a single specimen of this rare bug in a chalk-pit between Eccles and Burham, Kent. This appears to be only the fifth British locality.

In 1923 two specimens were recorded, one from Swalecliffe, Kent (E. A. Butler, 1923, *Ent. Mon. Mag.* **59**:130-31) and the other from Colesborne, Glouc. (J. Edwards, 1923, *Ent. Mon. Mag.* **59**:130). No more was heard of the species in Britain until several specimens were captured on August 11th, 1944, at Stroud Common, Glouc. by the late T. Bainbrigge Fletcher. Since then B. J. Southgate, in correspondence with Dr. A. M. Massee, reports the occurrence of the species at Brean Sandhills on September 3rd, 1953.

I wish to thank Dr. A. M. Massee for confirming my identification of the specimen and also for tracing the earlier records.—K. C. SIDE, 107 London Road, Stone, Dartford,

THE DISTRIBUTION OF *MANTIS RELIGIOSA* L. (DICTYOPTERA, MANTIDAE)

BY A. N. BRANGHAM

Dr. David Ragge's (1959) interesting note that a female specimen of *Mantis religiosa* L. was discovered on the South Downs on October 17th, 1959, prompts the observation that the range of this species has tended to spread northwards on the Continent of Europe in recent years. Dr. J.-P. Vanden Eeckhoudt (1958) has recorded that it first appeared in clearings of the Forest of Fontainebleau at the beginning of this century. Shortly before the outbreak of the 1939-45 war it was taken in the southernmost district of Belgium, while more recently, it has been found further north in clearings in the Ardennes.

M. religiosa is the only European representative of the Mantidae to have spread northwards from the Mediterranean region (where its variable colour forms, ranging from green to yellow, are common). Outside the Mediterranean it is confined to xerothermal localities of shrubby or grassy wasteland and to vineyards to a lesser degree. M. Beier (1952) has said that the insect used to be more widely distributed in Europe than it is now, retreating since the middle of the nineteenth century as a result of the cultivation of wasteland which had previously formed its major habitat outside the Mediterranean. In the middle of the eighteenth century, for example, *M. religiosa* was comparatively common round Frankfurt-on-Main; at the beginning of the following century it was still to be found near Passau and the Rheinpfalz. Today the stenozones in Germany are in isolated places in Bavaria and Baden, as well as in Alsace and Lorraine, parts of Austria, Switzerland, Czechoslovakia, and southern Russia, according to Beier. In recent decades the insect has been introduced to southern Ontario and New York State, so that its northernmost limit appears to lie roughly along latitude 50° N.

The extension of its biotope depends on climatic conditions with relatively high minimal temperatures for the development and survival of imagines. This is indicated by its inability to develop below a temperature of 17° C. As the mantid's ability to spread and occupy fresh habitats is limited, the expansion of the breeding area in Belgium, instanced by Vanden Eeckhoudt, may be due in part to the introduction of ootheca attached to stones which have been transported from one suitable habitat to another by accident. If a general pressure towards northerly habitats is detected, it may be said that *M. religiosa* is reoccupying its ancient biotopes.

There is probably no climatic, but only a physical, barrier to its breeding in similar favourable localities in southern England, though there is no reason to supose that Dr. Thomas Muffet's charming but fanciful description of the '*Mantes*, that is, fortune-tellers' in the sixteenth century was derived from a personal knowledge of the insect in this country.

The protective value of the ootheca against low temperatures, suggested by J. H. Fabre (1917), is open to doubt, according to Vanden Eeckhoudt, on the grounds that the production of heat by the eggs within the ootheca is so infinitesimal as not to achieve more than insulation against very sharp alterations in the external temperature.

REFERENCES

Beier, M. & Heikertinger, F., 1952, *Fangheuschrecken, Leipzig*. **Fabre, J. H.** 1917, *The life of the grasshopper*, trans. by A. T. de Mattos, London. **Ragge, D. R.**, 1959, *Mantis religiosa* L. (Dictyoptera, Mantidae) in Sussex, *Ent. mon. Mag.*, **95**:273. **Van den Eeckhoudt, J. P.**, 1958, La Mante religieuse, *Science et Nature*, **30**:3-9.

'Four Ways', 85 Claremont Road, Tunbridge Wells, Kent.