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HOUSE-FLY (*MUSCA DOMESTICA*, Linn.)

ON THE HABITS, LIFE-CYCLE AND BREEDING PLACES OF THE COMMON HOUSE-FLY (*MUSCA DOMESTICA*, Linn.)

BY

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This paper is reprinted, by kind permission of Dr. E. W. Hope, Medical Officer of Health, from the preliminary report issued by the Health Committee of the City of Liverpool, 3rd October, 1907. Some additional facts regarding the habits of the house-fly have been obtained recently, but it has been thought desirable to embody these in the final report, together with the results of further experiments with insecticides, disinfectants, and other methods of control.

"This investigation was conducted chiefly with the view of ascertaining the nature and extent of the breeding places of the common house-fly (*Musca domestica*) in the City of Liverpool; and also the period of the life cycle of the fly under varying atmospheric and other conditions; so that some practical measures might be devised for the destruction of this pest.

"In addition to the common house fly, other species of flies also occur in dwellings and shops, and several species were bred from ash-pit refuse, human excreta, &c. One of these, the common blow-fly, or blue-bottle (*Calliphora erythrocephala*), may also prove to be a very important contributory factor in the spread of zymotic diseases, but it is intended, for the sake of clearness, to deal with these additional species in the Appendix to this Report.

"In the popular mind the term 'house-fly' is applied to almost all kinds of two-winged flies which are commonly met with in the dwellings of man. To the zoologist, however, there is but one true house-fly, and this is the *Musca domestica* described by Linnaeus in 1758. This fly is by far the commonest species met with, and quite 90 per cent. of the flies which infest houses in Liverpool are of this kind.

" Altogether, the refuse from over three hundred ashpits and bins (chiefly the former) was examined, and 37 middensteads carefully inspected. Human excreta found in the courts and passages were also inspected, and breeding-cage experiments with these and the excreta of domesticated animals were also conducted. The survey was restricted to five areas in different parts of the City embracing, in all, visits to 68 streets.*

" The result of the investigation and survey has proved eminently satisfactory, both from an economic and scientific standpoint. It has led to the discovery of the chief breeding places of the fly, and many new and interesting facts relating to the food of the larval stages have been brought to light; so that we are now in possession of the more important facts relating to the economy of this pest.

" The chief breeding places of the house-fly may be classified under the following heads:—

- " 1. Middensteads containing horse manure only.
- " 2. Middensteads containing spent hops.
- " 3. Ashpits containing fermenting materials.

" Leaving for the present the minor breeding places, we may proceed to consider the chief ones in detail.

" 1. Stable middens containing horse manure only, were broadly speaking, found to be the chief breeding places. In the majority of these the larval stages of the house-fly occurred in countless thousands, revelling in the heat produced by fermentation. The adjacent walls often swarmed with newly-hatched flies, and occasionally one also found enormous masses of their eggs (fig. 2), while deep down at the sides, in the cooler portions of the receptacles, the pupa or chrysalis stage occurred in enormous numbers, looking like small heaps or collections of reddish berries. Middens containing a mixture of horse and cow dung were also infected, though to a less extent than those receptacles containing horse manure only. It is important to note, however, that in all cases where fowls (not ducks or geese) were kept and allowed freedom in the yards, relatively few of the earlier stages of the house-fly were found; and whenever present were invariably located in places inaccessible to the fowls. To make certain that the fowls were responsible for so remarkable a diminution of the fly larvae and pupae, a trowel full of these was

* The list of streets and also the nature of the receptacles are here omitted.—R.N.

thrown to some fowls, when they were eaten with as much avidity as if they had been so many grains of wheat. However much, therefore, we may deprecate the keeping of fowls in large towns, we must, from the evidence which has been adduced, consider them as important contributory factors in the destruction of the earlier stages of the house-fly. It should be pointed out, however, that fowls are kept in a very few of the stable yards, so that in the majority of cases the flies go on breeding uninterruptedly, and, so far as one can gather, the larvae and pupae have few, if any, other natural enemies but those already mentioned.

"In one case, where large quantities of a disinfectant (Sharrant's disinfectant powder) were used in the stable, no larvae or pupae were found in the manure, though they were swarming in a mass of waste hops in a separate division of the same midden. Fly larvae were also absent in another instance where chloride of lime had been used freely. However, one is not prepared, at the present moment, to state definitely that the presence of either of these agents had any deleterious effect on the fly larvae, or that they acted as a deterrent; it may have been a simple coincidence, and the matter requires further investigation.

"All types of middensteads were infected—*roofed, vaulted and open.*

"The photographs (figs. 6-9) submitted with this report will afford some idea of the enormous numbers of the earlier stages of the house-fly which were found in stable manure.

"2. Only one midden containing warm spent hops was inspected, and this was found to be as badly infested as any of the stable middens. The pupae (fig. 12) were found collected together in large masses, and the larvae swarmed in the warmer parts of the material.

"3. A great deal of time was given to the inspection of ashpits, and it was found that wherever fermentation had taken place, and artificial heat had been thus produced, such places were infested with house-fly larvae and pupae, often to the same alarming extent as in stable manure. Such ashpits as these almost invariably contained large quantities of old bedding or straw and paper, paper mixed with human excreta or old rags, manure from rabbit hutches, &c., or a mixture of all of these. (See figs. 10, 11.)

"About 25 per cent. of the ashpits examined were thus infested.

"House-flies were also found breeding, in smaller numbers, in ashpits in which no heat had been engendered by fermentation.

"Both open and closed ashpits were infested, but on the whole the flies gave preference to the closed receptacles. On opening the doors of some of the covered ashpits, the flies often came away in hundreds, appearing like bees round a hive. Ashpits which had been previously treated with disinfectants were also infested.

"In addition to the foregoing, there were also other collections of material which afforded temporary breeding places. They are considered under the following heads:—

"1. Collections of fermenting vegetable refuse.

"2. Accumulations of manure at the wharves.

"3. Bedding in poultry pens.

"1. Collections of straw mixed with other vegetable matter and feathers, lying in open spaces in poultry yards, were found to contain enormous numbers of house-fly pupae (fig. 13). The materials had evidently fermented, and had also been lying exposed to the weather for a period of not less than eight weeks.

"2. The large accumulation of stable manure lying at the wharf (Carruthers Street) was swarming with fly larvae, and the flies occurred also in large numbers; so that it is quite evident that a number of the insects hatch before the manure is placed in the barges for transmission to the country. Practically all the manure is badly infested when it reaches the wharves, so that it is important that it should be shipped with as little delay as possible.

"3. The common practice of leaving 'bedding' material (chiefly long straw) in poultry pens (containing ducks, geese, &c.) until fermentation takes place, affords breeding places for house-flies, and such material should be removed at much shorter intervals.

"Temporary breeding places destroyed by speedy removal of refuse:—

"1. Collections of stable manure removed at short intervals.

"2. Ashpits emptied at intervals of 7-10 days.

"3. Bedding in piggeries.

"1. Ashpits emptied at intervals of about 14 days may be considered as temporary breeding places, the period between the removals being too short for the fly to complete its life cycle. Only under very unusual circumstances, where, for instance, a large amount

of fermenting materials are thrown into the receptacle immediately after it has been emptied, would it be possible for the insect to complete its metamorphosis in so short a period. In the majority of cases, therefore, ashpits emptied at such short intervals can only be considered as temporary breeding places.

"2. Larvae of the house-fly occurred in large numbers in the receptacle used for holding stable manure in the Corporation Yard,* Mill Lane. As the manure is removed from this place every week, it is impossible for the flies to complete their metamorphosis in it.

"3. 'Bedding' in the 'piggeries' which had been in use for a few days was found infested with fly larvae. The material used as 'litter' was wood chips. This refuse does not lie sufficiently long for the insect to complete its metamorphosis.

"The non-breeding places were:—

"1. Middens containing excessively moist and non-fermented cow-dung.

"2. Patent ash bins.

"3. Refuse in ashpits saturated with water.

"4. Human excreta lying in courts and passages.

"1. No trace of house-fly larvae or pupae was found in any of the middens containing cow manure exclusively. The excessive amount of moisture present in this material was evidently unfavourable to the development of the larvae. But in all cases where horse manure was mixed with it, and fermentation had taken place, larvae were present. The admixture of straw with cow manure would produce similar results.

"2. No house-flies were found breeding in the patent bins, which is due to the fact that they are emptied daily, or at intervals of a few days.

"3. No house-flies were found breeding in excessively dry refuse, or refuse thoroughly saturated with water and reeking with inky black putrid matter.

"4. Human faecal matter found lying in the courts and passages was not infected with fly larvae, and no house-flies were bred from such matter. But human excreta found in ashpits (several instances) and stable middens (two cases) were found to be infested.

* It is interesting to note that the bedding material used at this place was sawdust.

"Reference has already been made to the more important materials in which the larvae were found breeding, but no details have been given as to the exact nature of their food. The dietary, so far as one has been able to see, is almost exclusively that of moist decaying vegetable matter. Horse manure and spent hops were most favoured; but they revelled also in rotten flock beds, straw mattresses; they thrived on old cotton garments and rotten sacks, and waste paper; and seemed especially partial to the dirty beddings from rabbits and guinea pigs. They fed also on bread, decayed fruits and vegetables, the excreta of domestic fowls and pigs, and on human excreta in the ashpits and stable middens. In all cases, however, they thrived best and occurred in the greatest profusion where fermentation had taken place, so that the temperature of the habitat was raised above that of the outside air.

"Like nearly all its congeners, the house-fly undergoes a complete metamorphosis, in which there are *four* well-marked stages; these stages in the life cycle are:—

- "1. The egg (ovum), commonly known as 'fly-blows.'
- "2. The larva or maggot stage.
- "3. The pupa or chrysalis stage.
- "4. The imago, or perfect fly. (The final stage.)

"1st Stage.—*The eggs* are laid in small irregular clusters, or in large collective masses* (figs. 1, 2) consisting of many thousands of individual eggs. They are almost invariably deposited on or in such substances as will provide food for the larvae or maggots. They are usually placed in narrow crevices near the surface, but, occasionally, also at a distance of from four to six inches below the surface, the *favoured spots* in all cases being fermenting vegetable matter or the refuse lying immediately over such materials, or in refuse that is likely to ferment. They are often laid, however, on materials which do not ferment, and in all such cases (in this country, at least) the developmental cycle is greatly prolonged.

"The eggs are pure white, and present a highly polished surface, due to the clear, viscous substance with which they are coated. The form of the egg may be seen on referring to the micro-photographs

* I have witnessed as many as 78 females laying their eggs in one small area, the flies being closely packed together. When disturbed they flew away, but returned again to the same spot in a few minutes.—R. N.

(figs. 3, 4), and the actual size is shown in fig. 1. The larvae or maggots hatch from these in periods varying from eight hours to three to four days; the average time may be given as twelve hours, but when laid in fermenting materials the incubation period is reduced to a minimum of eight to twelve hours.

"The number of eggs laid by a single fly averages from 120 to 140. More than one batch may be laid during the life of the fly, but this question has not been definitely settled.

"2nd Stage.—*The larva or maggot* (fig. 9) resembles that of the common 'bluebottle-fly,' or 'Blow-fly' (*Calliphora erythrocephala*), but is much smaller, measuring when fully matured nearly half an inch in length, and is distinguished also by certain anatomical characters. It is essentially a vegetable feeder; animal matter is eaten only, so far as one has been able to gather, when in the form of human faeces. It was never found feeding on the carcasses of dead cats and dogs or of birds and fish remains.*

"They thrive and mature most rapidly, and are always most abundant in fermenting materials; but they can also mature in non-fermenting substances during warm weather, though under such conditions they do so very slowly. In stable manure they are generally most numerous a few inches below the surface, and undoubtedly work their way upwards day by day into the fresh material, a few hours (five to six) after it has been added to the previous accumulation. This marked habit is evidently due to the excessive heat which is engendered in the lower strata of the manure.

"Under the most favourable conditions as to temperature and food supply they mature in five to eight days; but, where fermentation does not take place, this stage, even in hot weather, may be prolonged to several weeks (six to eight). In middensteads the fully matured larvae crawl away to the sides or to the top of the wall or framework of the receptacle; in ashpits they locate themselves in various materials as well as ashes, but are evidently partial to old bedding, paper and rags, usually in or near the centre of fermentation. After emptying the alimentary tract of organic matter, pupation takes place rapidly, and the third stage is reached.

"3rd Stage.—The pupa or chrysalis (figs. 7, 10, 11) is at first of a pale yellowish colour, but rapidly changes to bright red, and finally to a dark chestnut colour. It is somewhat barrel-shaped, and varies

* Taschenberg in 1880, states that he found eggs on the carcasses of dead animals, but does not indicate that the larvae will breed in such substance.—R. N.

in length from $\frac{2}{12}$ - $\frac{3}{12}$ of an inch. Small examples are found where the temperature has been low or excessively hot and somewhat dry. Large examples invariably occur in fermented materials, more especially so in stable manure.

"In stable middens the pupae occur chiefly at the sides or at the top of the wall or framework of the receptacle, where the temperature is lowest. In such situations they were often found packed together in large masses numbering many hundreds (see figs. 6, 7). The flies emerge from the pupae, under the most favourable conditions, in five to seven days. In ashpits they occur in the positions already indicated, and if similar conditions as to heat prevail, the period is approximately the same; but in all cases where heat is not produced by fermentation, the pupal stage may last from 14 to 28 days, or even considerably more.

"4th Stage.—The perfect fly escapes from the pupa by breaking away the anterior end; this it accomplishes by inflating the frontal sac, which is situate in the front portion of the head, between the eyes. By the inflation of this sac, the fly is also enabled to force its way through the manure or ashes into the open air. When once it has liberated itself, the wings develop, and when the integument has sufficiently hardened the fly takes to wing. Pairing then takes place, eggs are laid, and another generation is started. The whole cycle from egg to perfect insect occupies, under the most favourable conditions, from ten to fourteen days; but in low temperatures the whole cycle may extend to several weeks. No growth takes place after the wings are developed.

"That the flies migrate from their breeding places to man's dwellings is quite evident, even to the layman, the primary object being apparently to obtain food and shelter. Many flies are also found in such places during winter and early spring, though whether they pass the winter entirely in this stage one has not yet been able to ascertain. It is highly probable, however, that some pupae* may remain over the winter and hatch in the following spring. Now that the breeding places have been discovered, it will be a comparatively easy matter to ascertain if this is the case or not.

* A single pupa evidently of the house-fly was found during the winter months, but this unfortunately did not produce a fly in the following year.

"Little need be said as to the food of the fly itself, as every layman is conversant with the feeding habits of this little filth-carrying insect. But the contributory part which many authorities have claimed that this insect plays in the transmission of zymotic diseases is due to the almost persistent habit it has of feeding or alighting upon human excreta.

"In the course of my investigations, more especially on hot days, numbers of house-flies were seen hovering over or feeding upon such matter. The faeces were generally those of children, and were lying, as a rule, a few feet from the doorways in the courts or in the passages behind the houses. In one instance no less than five patches of human excreta were lying in one court, and all of these were attended by house-flies.

"Temperature, as has already been stated, has a most marked effect upon the developmental cycle of the fly; and a sudden check from heat to cold will materially prolong any one of the stages. Eggs hatched in eight to twelve hours in a temperature of from 75° to 80° F., at a temperature of 60° F. in twelve hours, but at 45° F. they did not hatch until the third day, and then only when placed in a warmer temperature for the purpose of studying them under the microscope. The larvae or maggots mature in the shortest period in fermenting materials at a temperature of between 90° and 98° F., but they usually leave the hotter portions of the stable manure when it reaches a temperature of 100° to 110°. At 54° F. both larval and pupal stages are considerably prolonged; larvae kept at this temperature had not matured at the end of eight weeks, and a number of pupae kept under similar conditions did not produce flies until the fourth and fifth weeks.

"In this Report I have endeavoured to show that:—

"I.—The chief breeding places of the house-fly are:—

- "(A) Stable middens containing fermenting horse manure or a mixture of this and cow dung;
- "(B) Middens containing fermenting spent hops; and
- "(C) Ashpits containing fermenting vegetable matter, or about 25 per cent. of the total number of pits examined.

"II.—That covered ashpits and middens were as badly infested as those which were open.

- " III.—That house-flies breed in all temporary collections of fermenting matter.
- " IV.—That house-flies breed in relatively small numbers in ashpits where no fermentation takes place.
- " V.—That they do not breed in ashpits which are *emptied at short intervals*, or in the *patent bins*.
- " VI.—That the use of disinfectants in ashpits does not prevent the flies breeding in such receptacles.
- " VII.—That very dry or excessively wet ashes or moist cow dung* does not harbour them.
- " VIII.—That the presence of fowls (not ducks or geese) which had free access to the stable middens reduced the number of larvae and pupae to a very marked extent.
- " IX.—That the life cycle of the fly, in all kinds of fermenting materials, is reduced to the minimum period of ten to fourteen days; and that in the absence of such artificial heat the cycle may occupy a period of from three to five weeks or more, according to the temperature of the outside air.
- " X.—That house-flies do not depend entirely upon excessively warm weather for breeding purposes, though in hot seasons they would breed much more rapidly in non-fermenting materials, and their numbers, under such conditions, would be greatly increased.

" If house-flies are to be reduced to a minimum, I would . . . submit the following suggestions . . .

" 1. That stable manure and spent hops should not be allowed to accumulate in the middensteads during the months of May to October inclusive, for *a period of more than seven days*.

" 2. All middensteads should be thoroughly emptied and carefully swept at the period stated in 1.

" The present system of *partly emptying* such receptacles should in all cases be discontinued.

" The walls of middensteads should also be cemented over, or, failing this, the brickwork should be sound and well pointed.

* In excessively hot summers cow dung may form a breeding place for the house fly. The admixture of a large quantity of bedding (straw or sawdust), would also render it suitable for breeding purposes.

"3. That all ashpits should be emptied, during the summer months, at intervals of not more than ten days.

"4. That the most strenuous efforts should be made to prevent children defaecating in the courts and passages; or that the parents should be compelled to remove such matter immediately; and defaecation in stable middens should be strictly forbidden. The danger lies in the overwhelming attraction which such faecal matter has for house-flies, which latter may afterwards come into direct contact with man or his foodstuffs. They may as Vedeer* puts it, 'in a very few minutes . . . load themselves with dejections from a typhoid or dysenteric patient, not as yet sick enough to be in hospital or under observation, and carry the poison so taken up into the very midst of the food and water ready for use at the next meal. There is no long roundabout process involved.'

"5. Ashpit refuse, which in any way tends to fermentation, such as bedding, straw, old rags, paper, waste vegetables, dirty bedding from the 'hutches' of pet animals, &c., should, if possible, be disposed of by the tenants, preferably by incineration, or be placed in a separate receptacle so that no fermentation could take place. If such precautions were adopted by householders, relatively few house-flies would breed in the ashpits, and the present system of emptying such places at longer intervals than, say, four to six weeks, might be continued.

"6. The application of Paris Green† (poison) at the rate of 2 ozs. to one gallon of water to either stable manure or ashpit refuse will destroy 99 per cent. of the larvae. Possibly a smaller percentage of Paris Green might be employed with equally good results.

"One per cent. of crude atoxyl in water kills 100 per cent. of fly larvae.

"The application of either of these substances might, however, lead to serious complications, and it is very doubtful whether they could be employed with safety. Paris Green, at the rate of 1 to 2 ozs. to 20 gallons of water, is used largely as an insecticide for fruit pests. It does no harm to vegetation when applied in small quantities; but cattle might be tempted to eat the dirty straw in manure which had

* M. A. Vedeer, M.B. 'Flies as spreaders of sickness in camps.' Medical Record, Vol. LIV (1898), pp. 429-430.

† This substance is a definite chemical compound of arsenic, copper and acetic acid.

been treated with this substance, and the results might prove fatal if large quantities were eaten.

"7. The use of sun-blinds in all shops containing food which attracts flies would, in my opinion, largely reduce the number of flies in such places during hot weather. Small fruiterers' and confectioners' shops, as a rule, are not shaded by sun-blinds, and in their absence flies literally swarm on the articles exposed for sale.

"8. The screening of middensteads with fine wire gauze would, undoubtedly, prevent flies from gaining access to manure, &c., but it is very doubtful if this method would meet with any marked success. The gauze would rapidly oxidise, the framework supporting it would probably warp, and numbers of flies would be admitted whenever the receptacle was opened. Moreover, the erection of such a structure would prove a great inconvenience and a hindrance to the removal of the refuse. This, however, does not prejudice the possibility of erecting a good fly-proof screen in the future.

"Experiments with crude carbolic acid, cresylic acid, &c., are being conducted, and the results will be reported later.

"In the introductory remarks on the house-fly, reference has been made to other flies which were found frequenting houses, or were bred from refuse and excreta during the course of investigation. The following is a list of the insects, together with short notes on their habits and prevalence:—

"1. *Calliphora erythrocephala*. The 'Blow-fly.'

"In some parts of Liverpool this fly is quite as abundant as the house-fly, and, like the latter, may, from its disgusting habit of feeding upon faecal matter, also act as a contributory agent in the spread of zymotic diseases.

"This fly feeds upon the faeces of man to a greater extent than the house-fly; moreover, it is also partial to fruits of various kinds, especially over-ripe plums and grapes and dried figs and dates, so that one can readily conceive how it would be possible for the flies to mechanically transmit the germs of disease from faecal matter to fruit, and as a large percentage is eaten uncooked, the transmission of infected faecal matter, if present, would be direct.

"The female insect lays its eggs in all kinds of raw and cooked meat, the carcasses of mammals, birds, fish, &c., and wherever such remains were found in ashpit refuse, the larvae of this insect swarmed.

" 2. *Scatophaga stercoraria*. 'Dun' or 'Yellow Cow Fly.'

" This is a rather large yellow fly which abounds in the country, but is relatively scarce in the city of Liverpool. It breeds in cow dung, and was occasionally seen in some of the middens. It rarely enters houses, and is therefore of no economic importance.

" 3. *Borborus equinus*.

" A minute fly which literally swarms in stable manure all over the city. As it rarely enters houses or shops, it is of no economic importance. Fowls eat large numbers. It breeds in the faeces of the horse.

" 4. *Stomoxys calcitrans*. 'The Stable Fly.'

" This is a blood-sucking insect, and is one of the recognised carriers of Trypanosomiasis in tropical countries. In 1906 it was common in some parts of Liverpool, but this year it has been quite scarce. It breeds in fermenting horse manure and grass mowings. It sometimes enters houses and bites both man and his domesticated animals. Of little economic importance in Liverpool.

" 5. *Homalomyia canicularis*.

" This species is often common in the dwellings of man, and is for this reason often mistaken for the house-fly. In Liverpool, however, it is by no means abundant, and not more than one per cent. of the flies captured in fly-traps are of this species. It breeds in horse manure, and possibly also in the faeces of other animals.

" 6. *Anthomyia radicum*. 'Root Fly' or 'Root Maggot.'

" Closely related to the foregoing species, but not common in Liverpool. A few examples were captured in fly-traps; but no specimens were bred from refuse of any kind.

" 7. *Homalomyia scalaris*.

" The larvae of this species were frequently seen in ashpit refuse; and a number of these flies were bred from human faeces. It is not a very abundant species, however, and so far as my investigations have gone, it has not been found very often in houses or shops. The larvae feed on all kinds of faecal matter, and are especially partial to human excreta; they revel in privies, often congregating together on the shield board in hundreds. Cases of intestinal myiasis in man have been attributed to the larvae of this fly.

"8. *Psychoda* (?) *phalænoides*. 'Owl Midge' or 'Moth Fly.'

"A minute moth-like insect often seen on window-panes in houses. The larvae of this insect were common in human faeces, and many examples of the flies were bred from this material. It is also common in putrid sewage matter. May be looked upon more in the light of a scavenger, but is of little or no economic importance.

"9. *Coleoptera*. (Beetles.)

"Two species were particularly common in ashpits, viz., *Creophilus maxillosus* and *Philonthus politus*. They act as scavengers, feeding upon all kinds of débris. They rarely enter houses."

FIG. 1. FOUR BATCHES OF EGGS.
NATURAL SIZE

FIG. 2. COLLECTIVE BATCHES OF EGGS IN
STABLE MANURE, NUMBERING ABOUT
1,500. NATURAL SIZE

FIG. 3. EGGS ENLARGED

FIG. 4. EGGS GREATLY ENLARGED; ONE SHOWS THE SEGMENTS OF THE LARVA THROUGH THE CUTICLE

FIG. 5. LARVÆ AND PUPÆ IN WASTE PAPER (ASH-PIT REFUSE).
NATURAL SIZE

FIG. 6. MASS OF ABOUT 200 PUPÆ IN STABLE MANURE.
NATURAL SIZE

FIG. 7. MASS OF PUPÆ SEPARATED FROM STABLE MANURE SHOWN IN FIG. 6.
NATURAL SIZE

FIG. 8. MASS OF LARVÆ IN STABLE MANURE. NATURAL SIZE

FIG. 9. MASS OF LARVÆ SEPARATED FROM STABLE MANURE
SHOWN IN FIG. 8. NATURAL SIZE

FIG. 10. LARVÆ AND PUPÆ IN OLD "FLOCK" BEDDING.
NATURAL SIZE

FIG. 11. LARVÆ AND PUPÆ IN OLD RAGS (ASHPIT REFUSE).
NATURAL SIZE

FIG. 12. MASS OF PUPÆ IN SPENT HOPS. NATURAL SIZE

FIG. 13. PUPÆ IN FEATHERS AND STRAW, FROM POULTRY YARDS.
NATURAL SIZE