HOUSE FLIES AND THEIR WAYS AT BENARES.

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The following observations were made at Benares, India, at the end of the cool season and beginning of the hot weather (February to May), at a time when there is scarcely any rain.

Finding a fair number of flies about in the cantonment, in spite of the dryness of the ground and the absence of manure, one began to ask where the insects came from, and no one seemed to know. A hospital attendant, in explanation, produced a piece of string with fly deposits on it and claimed that these little black spots of excrement were flies' eggs. He was not by any means alone in holding this opinion.

In this country almost every scrap of cow-dung deposited is picked up at once and moulded into thin, flat cakes, which are rapidly dried in the sun and stored for fuel. So valuable is this commodity, that the cowherd often carries a basket in which to collect the droppings of the animals at the earliest possible moment. Horse- and donkey-dung is also used for fuel and, moreover, seems to dry up so rapidly, that larvae would, it might be supposed, not have time to develop in it under an Eastern sun in dry weather.

The filth trenches used for the contents of latrines are too far away from cantonments to be taken into account. Isolated deposits of human ordure are regarded as harmless. On my suggesting, indeed, apart from any connection with the breeding of flies, that such deposits among the outbuildings of an officers' mess are undesirable, I am politely corrected by a regimental officer, who informs me that anyone with Indian experience knows that human excrement dries up in three days under the Eastern sun, and may therefore be disregarded in the sanitary sense. The observations which have been made show, among other things, that human excrement does dry up in three or four days, at certain seasons of the year; they also show, however, a new reason for regarding it as by no means harmless even in single deposits.

The first step of enquiry was, to find out what insects concerned

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1 See p. 691 of the Royal Army Medical Corps Journal, December, 1906, Captain G. D. Franklin, I.M.S., also p. 224, February, 1907, Captain C. H. Straton, R.A.M.C., concerning filth trenches and flies.
us; and in this regard it was noticed at once that the majority of the species of flies about us were not likely to be harmful to man—unless indeed, they polluted his drinking water.

Flies captured in the men's rooms, in hospital wards and in kitchens, were almost entirely of one or other of two varieties, viz., *Musca domestica* and *Musca enteniiata*. Flies taken off ward utensils in the verandah annexe were *M. domestica* and *M. enteniiata*. These are the flies which, in the season of the year dealt with, are at home in barracks—flies which settle upon food or drink, wander about the person and upon bedding, tablecloths, plates, cups, &c. Other species may occasionally get into a room, but they mostly buzz about the windows and seem anxious to get out again to the open air. Two other species, one resembling *domestica*, the other roughly like *enteniiata*, but both unidentified, were taken in the neighbourhood of dwellings. They have not yet been incriminated. One rather ornamental fly (*Anthomyia tonitrui*), generally resembling the smaller house flies, but having transverse white bars on the thorax, was frequently found sitting on walls and furniture in verandahs and offices; but it seemed to be merely taking refuge from the heat. Its interest in man, if it has any beyond breeding in human ordure, was not discovered.

In this part of the world deposits of human excrement are dotted about everywhere. Outside cantonments and cities the natives use chiefly the open country for the purposes of nature—latrines are not in fashion. Sheltered places, such as a watercourse, the banks of a pond, a garden, or a field containing a standing crop, find favour in this regard. Running along the back of the barracks and hospital here, and just on the cantonment border, is a stream which in March was nearly dried up, and consisted of a series of pools. Once in March and again in April a downfall of rain filled the stream in a night to overflowing—the water having risen rapidly 6 feet or so and rapidly subsided. On May 3rd the stream bed was quite dry. The banks of this stream (which is a sub-tributary of the Ganges) and the dry portions of the bed are largely resorted to by natives as a latrine. Excrement deposited in places such as those above-mentioned is very quickly dried on its external surface, in the sun, but not before flies have deposited eggs or maggots, as the case may be, upon it. The surface of the mass becomes a more or less impervious covering which retards evaporation and thus allows the interior to remain moist for three or four days.

On turning over a three days' old deposit of faeces, a mass of
maggots was disclosed beneath. The disturbed maggots at once began to make for cracks in the earth or to go down dung-beetle holes and worm holes. Meanwhile ants attacked them and carried off some. White ants had already begun to weaken the defensive wall of faeces by eating it away. The faecal covering was replaced, but on the following day nothing remained but dry, hard faeces, no longer adherent to the ground. The faecal mass crumbled up and in a few days all trace of it had gone. Where were the maggots?

Digging into the soil below a faecal deposit four days' old, brought to light many maggots at a depth of 5 or 6 inches. Larvae, and the earth in which they had been found, were placed in a jar under a net. Fourteen days from the estimated hour of their birth as larvae the flies appeared and proved to be *M. entomiiata*. A good many similar observations have been made, and always in the main with like result, but often with much fewer flies and sometimes with different species of flies.

Sometimes the digging below a dried deposit did not bring to light any maggots, though plenty had been present in the same faeces before it became dry. This was the case with a deposit on some hard, dry soil in a flower-pot—sections of the earth were made in vain—nevertheless, from this soil under a net, flies appeared on the fourteenth and fifteenth days.

It may be surmised that under natural conditions the flies are able to get to the surface by the same channel which the maggots went down. In glass jars containing faeces on earth which had been disturbed in the course of removal to the jar, flies have been seen struggling for more than twenty-four hours in apparently vain efforts to get through the earth lying between them and freedom; nevertheless, many found a way through this earth.

Flies obtained from human ordure here, and identified, have so far been *M. entomiiata* and *A. tonitrui*. Unidentified, from same source, a large, robust, grey fly with red brown head and three dark bars along the thorax. Of these three only the first-mentioned frequents wards and rooms. The production of flies from sources such as those described must be enormous, for the country is being continually dotted with faeces.

Incidentally, one sees how the bed of a stream, or any depressed portion of ground, becomes impregnated with intestinal bacilli. The maggots and dung-beetles must take down many bacilli on their bodies and the germs will be protected from the sun by the overlying soil. It is conceivable indeed, that the newly emerged fly or beetle may be already a carrier of intestinal microbes, as
a legacy from his maggot forbear, and before the fly itself has encountered infected feces. Observation of the stream above-mentioned leads to the estimation that there is not a square foot of the bed which has not received a fecal deposit during the year.

Dog excrement is also concerned in the production of flies. From quite a small deposit in front of the hospital—weight perhaps 11/2 ounces—a crop of house flies, *M. domestica*, was obtained as early as the eighth day. It seems probable indeed, that any feces which remains moist for three days or so will support flies in the larval stage long enough to permit of the succeeding stages being gone through. From the droppings of fowls minute flies of unknown species were obtained.

The variations in the length of time occupied between the egg and fly stage seem wide and are presumably due to differences of nutriment, amount and duration of moisture, &c.

Cow-dung is similar to human ordure in fly-producing capacity. In the few deposits which escape the keen eyes of the fuel hunters, and therefore remain undisturbed, crowds of maggots live under the hard external surface. Such a deposit was noted to cover hundreds of maggots; next day none were found. Digging in the ground beneath and around brought to view a few maggots widely dispersed and at 2 or 3 inches depth. From these and from the soil in which they were found, as well as from similar deposits, the following flies among others were obtained, *M. domestica* and *M. entenatiata*.

Even in the afore-mentioned cow-dung fuel cakes, in spite of rapid drying, a few maggots (very few in dry weather) survive long enough to get into the pupal stage, and thus the fly population is swollen. Experimentally, flies have been bred out of fuel. In the moister season it may be that fuel will dry less rapidly and will consequently afford nourishment to a greater number of maggots.

Horse- and donkey-dung in single deposits has, so far, given only flies which are not domestic in habit. But the results might be different in less dry weather. From a collection of a day's fresh droppings of three horses, *M. domestica* were obtained on the eighth day after the laying of the eggs. Flies are much more numerous in native quarters than in barracks and European quarters. Habits before alluded to are sufficient explanation of this. Villages are full of cow-dung fuel and surrounded by human ordure. In our own cantonment village

1 In Mr. E. E. Austen's lucid article in the June number of the *Journal* for 1904 the house-fly is said to breed chiefly in horse-dung in temperate climates.
for natives, flies, though less common than in country villages, are much more numerous than in barracks; also owing partly to the keeping of cows and cow-dung fuel as well as to deposits of human ordure. For wherever there is a sheltered spot in the shape of a disused yard, an uninhabited, broken-down house, the back of a cow-house and so forth, there faecal deposits in abundance will be found; some of the yards, indeed, have been unauthorised public latrines. In the cantonment village maggots were found also in disused latrine pails and under slabs at the outlets of house drains, but the species was not ascertained. Flies, apart from those bred on the spot, may be supposed to be attracted, moreover, to the cantonment village and bazaar by reason of the greater amount of filth and smells there than in barracks.

Some idea of the comparative scarcity of flies in barracks—for all that has been said above—may be gathered from the fact that jam, sugar and milk may be exposed on the office verandah for, sometimes, an hour, without being once visited by a fly. (It is a different matter with highly odorous things, such as decomposing meat.) Indeed, the use of foodstuffs as baits for flies had to be abandoned. Whether flies would be equally rare in a country camp is another question, but evidently there are conditions here under which the fly population does not become oppressive; and these highly satisfactory sanitary conditions have been evolved in the course of time by the labours of the Medical Services of the Army. I have no hesitation in sounding the trumpet, inasmuch as being a new-comer in this country I have had no hand in the work.

By way of finding out if dead animals are the breeding grounds of house flies, a crow was shot and exposed for a day or two. Many house and other flies settled upon it. It was eventually enclosed in a net. On the fourteenth day after the crow's death, and six days after the maggots had assumed the pupal stage, innumerable flies were hatched out. They were all Pycnosoma orientale, which has not been found in rooms or wards, except as an unwilling occupant struggling at the window. Not one house fly appeared from the crow. This, however, is not conclusive testimony, for it seems usual to have a preponderance of one kind of fly in a medium. Not infrequently the flies from a specimen of human ordure have been all M. entaniata.

With the object of ascertaining whether flies breed in ordinary

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1 In Mr. Austen's afore-mentioned article, however, it is noted that other species of Pycnosoma were numerous and pestilential in camps in South Africa.
ground, as distinguished from organic deposits, the following observations were made. From a dampish grassy spot under a tree in the hospital compound, a spot where it was thought the ground was likely to be polluted by slops or urine, a square foot of earth about 5 inches deep was dug out. This earth was exposed for fourteen days in an open vessel, while being watered sufficiently often to keep it always moist. Similar portions of earth were obtained from alongside the latrine for natives, from a soiled wet patch in front of a native house and from a dry space in the hospital compound. The specimens were then placed under nets. In the course of a month no flies appeared.

Conclusion.—This paper does not profess to give an exhaustive list of all the breeding media of the house flies; it is merely an account of some of the breeding media of some of the house flies, and it represents work done in one's spare time when employed on ordinary Royal Army Medical Corps duty in hospital, barracks and cantonment. The gist of it is that man and his domestic animals provide the breeding media in their own excretions, and it seems likely that the flies will breed in whichever of these media be available.

The moral is obviously that we should pay increased attention to the cleanliness of the ground in regard to excreta and to the removal or destruction of excreta.

I have to thank Mr. E. E. Austen of the British Museum, who identified the flies, for this addition to many kindnesses received at his hands.

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