Fly Time

By E. LAURENCE PALMER

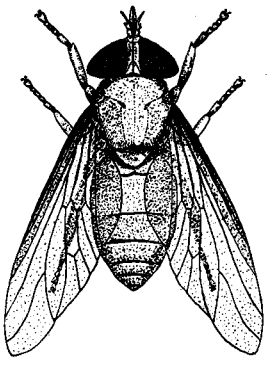
This is the fifty-first in NATURE MAGAZINE'S *series of educational inserts.*

Illustrated by Heinz Meng

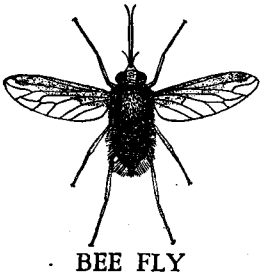
AN EARLIER insert of this series dealt with how time flies. This unit deals with fly time, a season which, fortunately, is gradually changing for most of us, and which in modern times has little resemblance to late summer and fall back in the horse and buggy days. The disappearance of horses from the streets, and of horse stables from our back yards, and the appearance of DDT and other effective sprays, make the canning season in most of our homes healthier, happier, quieter, more peaceful and less strenuous than formerly.

Some of you, no doubt, remember the steaming hot kitchens where canned goods were being "put up". It swarmed with flies from the nearby horse barn. You can still recall a perspiring parent with two flour-sack fly switches attached to the end of broom sticks chasing flies out the kitchen door, slamming the door to prevent the resurgent multitude from again taking over the premises. You can remember lying in bed watching the flies buzz about the ceiling, or being awakened by a fly crawling on your nose. You may even remember being sung to sleep with a little verse about the exceptional ability of a fly to crawl up the wall without falling. True, we still do have flies, and they still make trouble, but on the whole they have been made to take a back seat, at least in our homes and offices. In the woods, on the lakes and streams, and in other places, many of them still reign supreme, but even there their dominance is being threatened by the wholesale control techniques advanced by the economic entomologists. Some day we may even go to a summer resort and have to be introduced to a mosquito, blackfly, no-see-um, or deer fly, but I rather doubt if that time is to be expected in the immediate future. And when it comes we may find that, for some reason or other, the fishing in the hinterland is not so good as it used to be.

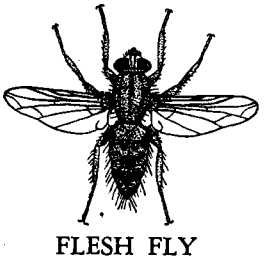
But what are these flies about which we have been talking? We have spoken freely of mosquitoes as flies, and were well within our rights in doing so. With equal justice, we could have mentioned midges and gnats as flies. In fact, there are in North America some 10,000 kinds of insects that properly can be considered as flies belonging to the order Diptera. With some minor reservations as to definition, we can assume that the members of this order are characterized in part by having two wings, hence the name diptera. They also have what entomologists speak of as complete metamorphosis: that is, they go through the standard egg, larva, pupa and adult stages in completing their life histories. Their behavior, type of mouth parts, food, economic importance, geographic distribution, seasonal abundance vary so greatly that these characters cannot be considered as definitive for inclusion or exclusion of insects from the order. So far, in this series of inserts, we have already given consideration to some flies. In the first unit, we gave illustrations and life history material on blackflies, midges, house mosquitoes and crane-flies. In the 36th, we added the house fly, the malarial mosquito and the yellow fever mosquito. We now add eighteen more to this list.



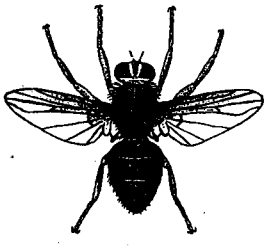
HORSE FLY



BEE FLY

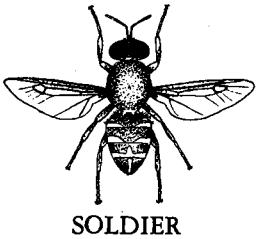


FLESH FLY



GREEN-BOTTLE FLY

DEER FLY



SOLDIER FLY

One cannot with safety consider that any insect that has the name fly identified with it is a true fly. Possibly there are as many insects spoken of commonly as flies, but which are not flies, as there are those that the average person recognizes as a true fly. So far in this series we have mentioned dragon flies, stone flies, damsel flies, dobson flies, caddis flies, may flies, and butterflies, all of which are not flies at all. Most of the major groups of insects are represented by some individual that has the term *fly* in its common name. The green fly of the gardener is really an aphid belonging to the group often considered as bugs. The Spanish fly and the firefly are beetles. The saw-flies are wasps, and the butterflies, of course, are to be found in still another group. It is dangerous, then, to jump to conclusions as to what a fly may be, although this danger does not seem to have been recognized by many of the leaders in science education, if we may judge them by their published materials.

Just as it is easy to become enthusiastic fans over butterflies, beetles, or wasps, so one can easily become a fly hobbyist. Ten thousand kinds of organisms in a group give one ample latitude to pick and choose one's field of investigation. As a matter of fact, almost any one of the 10,000 could well be better known with profit to the human race, so here is a wide open opportunity for anyone with the slightest interest in such matters. Ignorance, fantasy, prejudice, fear, superstition and other human emotions will be found to be identified with the study of flies, and some of these

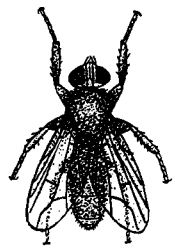
ROBBER FLY

should be modified if we wish to consider ourselves as rational organisms. The rewards will not be only in the realm of satisfying intellectual curiosity. Rather, anyone who can solve certain problems attendant on the control of many kinds of flies might well find himself free from economic worries for some time in the future. Great areas of the earth's surface, now relatively useless to man's economy, might well be made available to satisfy our needs if we could control the activities of the diptera found there. Camping without mosquitoes, blackflies, midges and no-see-ums would be a new experience to most of us. Polio, typhoid, malaria, lockjaw would not be the nightmares they now are could we eliminate flies and their activities from our neighborhood. But even here we would have to be selective, because some flies perform superior services in one way or another.

From the books of Exodus and Leviticus to the tomes of our modern medical societies, flies have been branded as blackguards. Moses declared them unclean, and Rosenau and others have proved it, but still the flies buzzed merrily about their business until we developed our modern insect sprays. And from one end of the country to the other we find communities that ignore what science tells them about flies. I recently visited a Wyoming town that each year has a polio epidemic on the lee-side of a polluted stream that carries away some of its sewage. In spite of this, each year new residents of the community are sacrificed to the inertia of the town. Why we can consider ourselves as "enlightened" people in the face of such examples is beyond me. True, we are better off than people in many other parts of the world, but, unless we really make use of the knowledge we possess, we have little with which we may flatter ourselves. Now we can undertake fly campaigns in whole cities, not just in our own homes or yards. We can practically eliminate the animals over considerable territories. Who knows but the spread of this practice may change the whole economy of the backward parts of the world, and areas that are now dependent on our bounty may find a greater happiness and prosperity through greater freedom from disease and more abundant energy.

The tables accompanying this section give some details regarding the relationships existing between certain flies and our health. Cholera, dysentery, diarrhea, typhoid, tuberculosis, lockjaw, poliomyelitis, and more than a dozen other diseases have been definitely associated with activities of flies. Domestic cattle attacked by flies lose flesh and have lower milk production. If attacked by warble flies, cattle may die, and even their hides may be found to be punctured in their most valuable areas by the fly larvae. Driven frantic by some species, animals may seek escape in flight and suffer violent injury, or may become mired in swamps and be drowned. Horses may be attacked, internally, by the larvae of bot-flies, and, externally, by ear-flies, and may either injure themselves through excessive activity or lose all excess energy and die.

Both men and other animals may find themselves supporting the larvae of flesh flies that may enter wherever the mucous membrane comes to the surface. Some of these may carry infectious diseases, in addition to causing pain and injury through actual destruction of living tissue.

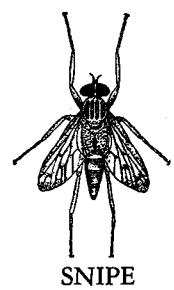


CLUSTER FLY

While we recognize these bad influences of flies, however, we may be inclined to forget some of the good things they do. The beautiful little syrphid or flower flies that hang about our fruits and flowers may perform a distinct service by killing aphids that destroy the plants. Even some of the flies that live in filth in their larval stage may, as adults, perform a useful service in the pollination of fruit trees. One orchard in New York State recently traced the success of its apple crop wholly to some drone flies that emerged from a filth-clogged ditch nearby at the very time the flowers were in bloom. The bees, which would have effected pollination normally, had been destroyed by the use of sprays.

LOUSE FLY

A reasonable examination of the data in the chart material will show the intricate relationships that may exist, as when some fly larvae destroy the parasites of harmful insects, thus rendering a disservice by an involved series of values. One of the dangers of wholesale campaigns against flies lies in the failure of these campaigns to be selective and to protect those creatures whose service to mankind may be obscure but none the less great.



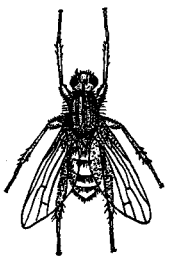
SNIPE FLY

FRUIT FLY

We may summarize some of the relationships between man and flies for the sake of convenience. They affect our food supply divergently. They may help in pollination and they may destroy plant tissues that are valuable. Garden crops, such as radishes, cabbages, lettuce, carrots and onions, are repeatedly destroyed by maggots of flies. Orchard crops similarly suffer injury that affects the salability of the crops and its real food value.

As predators, flies fill contrasting roles. If they prey on us, on our domestic animals, or on other useful animals, they, of course, arouse our ire. Sheep ticks are not popular with shepherds, and sheep ticks are flies. One wonders what would happen, however, if there were no syrphid flies to keep the numbers of plant lice down in our gardens. Predation of the type found with these flies is essential to a balanced existence under normal circumstances. We find different flies that prey on a great variety of animals. Some favor man, while others seek specific domestic mammals. Some seek birds, or specific groups of birds. Others find reptiles or amphibians suitable to meet their needs. A few use fishes as host animals, this, in a way, balancing the

STABLE FLY



DUNG FLY

LONG-LEGGED FLY

BIG-HEADED FLY

BOT FLY

credit sheet set up when a fish makes a generous lunch of flies.

Flies do provide a major source of food supply to many animals. Fish often depend largely on the larvae of aquatic species. Even humans of a primitive type have been known to collect flies and fly larvae and to use them as food. Some of our practices in wildlife husbandry depend on a source of fly larvae to serve as food for young game birds. Much experimentation has been under way to perfect the production of this type of food at a small cost, under inoffensive conditions and on a sustained, planned basis.

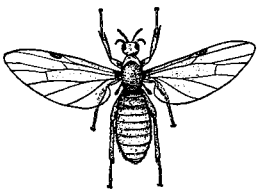
Flies have molded history for man again and again. Malaria and yellow fever defeated early attempts to build the Panama Canal. The tsetse flies of Africa have provided barriers more effective than those established by armies of men. Fly-borne epidemics have wrecked elaborate plans of men throughout history, and may have been instrumental in the extinction of many dominant animals in the geologic past. As a group the insects must be reckoned with in any plans we may make for the future. Mastery of them may mean success. Failure to control them may well mean failure. Modern armies recognize this.

As scavengers, flies may serve a role that has been overlooked. It is natural for some flies to seek filth, carrion and waste. The activity of the fly, or of its offspring, may well lead to a rapid reduction of the waste material. This is all to the good, but, unless some provision is made to prevent the spread of the filth, the consequences may be serious. Adult flies bred in filth may carry dangerous organisms for days after they have left their place of origin. This demands a limitation of their activities, or acceptance of the consequences.

Flies have served some obscurely useful functions in many fields. The larvae of some have been used in medicine in the removal of decaying tissue, much as have the larvae of some beetles. The fruit fly, *Drosophila,* accelerated tremendously investigations in the field of genetics by providing an easily cultured animal with significant secondary characters whose life cycle was completed in a short time. Because of this, generations could be studied in a few weeks, as against a few months or years or decades. The principles revealed by these studies were at least suggestive of what might be expected to find expression in other kinds of living things in the plant kingdom or in the animal kingdom.

Flies also react significantly to such physical phenomena as heat, light, sound, humidity and so on. Studies made of these tropisms, as found in flies, may be significant in understanding some other animals. We may expect further worthwhile investigations in this field. Eventually, we may be able to develop specific repellents that may bar dangerous and irritating species when such protection is necessary for comfort or efficient activities of man or of animals. The past decade has seen phenomenal progress in this field of investigation. What the next may yield will probably be even more important.

SYRPHID FLY



MARCH FLY

While the chemists have been exploring the likes and dislikes of flies, and the effect of various substances on the activities of these insects, the physicists, too, have had their problems. The mere mechanics whereby a large-bodied insect was able to fly at superspeeds with relatively small wings provided a real challenge to understanding. Ultra-speed photography has helped increase our understanding here. When one observer contended that one of the horse-fly group flew faster than any other living organism was able to move on the earth, others contended that a fragile organism such as the fly could not withstand the speeds involved. What the truth may be we do not here presume to suggest.

Meteorologists have pointed out that the behavior of some flies may indicate probable changes in the weather. Most of us have experienced particularly vicious attacks of some of the biting flies just prior to a storm, and we who have been in the woods much have recognized that while some flies bite actively in the sunlight others seem unable or unlikely to attack us except in the shade. Light and temperature condition considerably the behavior of many flies, without doubt. What the nice adjustments may be here we do not know. Neither do we know what fragrances attract or repel many of the flies that seemingly appear from nowhere when an animal dies or dung may be freshly deposited.

Flies have contributed to man's understanding of Nature in many ways. The old doctrine of spontaneous generation received a serious set-back some two hundred years ago when Redi demonstrated that meat could not produce flies spontaneously unless the flies could lay eggs on the meat. Since that time many observers and writers have chronicled the activities of flies. Fabre did this with a mastery equalled by few. Others may have made more intensive studies of fewer organisms, but few have provided the happy combination offered by this naturalist.

A distant relative whose house was always overrun with flies used to accept them philosophically. As long as she was satisfied that they came from her own barnyard, and were "her flies," rather than the filthy beasts that might have bred in a neighbor's yard, she did not let them worry

(*Continued on page* 424)

COMMON NAME SCIENTIFIC NAME	MARCH FLIES *Bibio sp.*	SOLDIER FLIES *Stratiomyia sp.*	HORSE FLY *Tabanus stratus*	DEER FLY *Chrysops vittatus*
DESCRIPTION	Gnat-like flies that may be either red, black or yellow, with relatively small but distinct heads, with the antennae usually shorter than the head. Legs, relatively short and stout. One species, *B albipennis,* is white-winged and relatively long-legged.	In most soldier flies the abdomen is broad and flattened, the wings at rest lying parallel and close or overlapping. Antennae are thick and of few segments. In many kinds, there are conspicuous yellow, black and green stripes across the abdomen. There is much variation, however.	Female, to 1 inch long, black, with blue-white bloom on the back. Wings, smoky. Eyes, separated. Outer wing margins not parallel. Male similar to female in general, but eyes touch each other and are proportionately much larger. Fast fliers and villainous biters of warm-blooded animals.	Length, to about ⅜-inch. General outline, triangular. Wings, with smoky bands and generally rather beautiful flies in every way except their behavior. Marvelous fliers. Eyes of the males touch each other, while those of the females are slightly separated. At rest, wing-spread is about ½-inch.
RANGE AND RELATIONSHIP	Family Bibionidae. The name March fly is misleading, as few appear by that date, and many not until autumn. The adults may appear about the flowers of the commoner fruit trees, although some on occasion enter houses and are found on windows with other flies.	Family Stratiomyidae. A large family well represented in North America with at least forty genera and over three hundred species. While most of the flies are found as adults near water or wet places, this is not true of all. Similarly the larvae are found in a variety of places.	Family Tabanidae. Relatives include gad flies, deer flies, and so on. Commonly found in woods, or in open about swimmers, or around cattle and horses. Not gregarious as are some flies. Some 200 closely related species are to be found in various parts of North America, usually in the warmer parts of the year.	Family Tabanidae. At least 63 species of deer flies, or ear flies as they may be called, are to be found in North America. Closely related to the horse flies and to the green-headed monsters, gad flies and breeze flies. Commonly found buzzing around the heads and ears of horses and of men.
REPRODUCTION	Larvae of March flies may live on decaying plant material, or feed on the roots of growing grasses, or even live in excrement of different kinds. The larvae have ten pairs of spiracles or breathing pores, which is a rather large number for the related flies.	*Stratiomyia* larvae are aquatic, slender grubs with a circlet of hairs at one end, which opens at water surface when air is taken in. Pupal stage is within last larval skin and is commonly found away from the water. Larvae of many species are predacious.	Eggs laid on marsh plants hatch in 1 to 2 weeks when exposed to sun. Larvae, greenish-white "worms," which in some species may be to 2 inches long, live in water or in moist soil. Usually winter in soil, and in spring form yellow-brown pupae to 1½ inches long. Adults emerge with the advent of warm weather.	Glistening black eggs are laid on water plants just above the water line, or on exposed stones at water's edge to form conspicuous patches. Larvae, worm-like, aquatic, drop into water to become ½-inch long before forming pupa that is not enclosed in the final larval skin.
HABITS	One species is known to carry the cause of fire-blight, a relatively common disease of pears and apples, although some question this relationship. The insects are often found in large numbers, forming flocks over fields and meadows during the warmer parts of the year.	Representative habitats for some genera of soldier flies are in decaying wood, *Pachygaster;* toilets, *Hermetia;* cow manure, *Myiochrysa;* under stones, *Geosargus;* in water, *Stratiomyia* and *Odontomyia.* Some are found in wasp nests and others commonly in mouse nests.	Food of larva and adult, other animals, the adult female feeding on the blood of warm-blooded animals. Bite is painful and is effected by cutting and piercing stylets that can cut through toughest hide. Known to carry *Bacillus anthracis* which may cause anthrax or lockjaw, and the trypanosome that causes surra.	Only the females bite, the males feeding on plant juices. Larvae feed on small aquatic animals; adult females on blood of men, horses, deer and other animals. Known to transmit blood parasite *Filaria diurna,* cause of filariasis, and *Bacterium tularense,* the cause of tularemia, both serious diseases of men.
ECONOMIC IMPORTANCE	Apparently of no outstanding economic importance, although the economic significance may not be fully appreciated. The association with flowers of fruit trees may be good, or, in the case of carrying disease, it may be bad.	Larvae may be scavengers in water or elsewhere. Others may be useful as predators. There does not seem to be any spectacular association of these flies with human health or comfort, although the larvae of some species may infest fruits, potatoes, and vegetables of a number of kinds.	May be more important in disease spread than is usually recognized. While they may be beautiful, they are never desirable companions. Their bite should not be permitted wherever it can be avoided. Fortunately they are abundant only in definite areas, and at more or less specific times of year and day.	Control is by draining of possible breeding places. Abundance may affect value of various areas for residential purposes. Ordinarily there is little danger in their bite, but serious consequences are possible, and the animals are rarely welcome anywhere. They may drive domestic animals almost mad, causing runaways.

SNIPE FLIES *Rhagio mystaceus*	BEE-FLIES *Bombylius sp.*	FRUIT FLY *Drosophila ampelophila*	ROBBER FLY *Asilus notatus*	LONG-LEGGED FLIES *Dolichopus sp.*
Medium-sized, slender flies with rather long legs, with abdomen tapering to the rear, and a rather onward-directed proboscis in front. In some species, there are patches of short, dense, contrastingly colored hairs, while in others the body is naked. Hairs, if present, are not long bristles.	Relatively small bee-like flies with narrow, widely spread wings, relatively large abdomens, small heads and abnormally long, straight probosces. The general appearance in the field is of a fuzzy fly that hovers and then darts suddenly in any direction. Color is usually dark or with dark wing marks like horse-flies.	Length, under ¼-inch. Wing-span, to ⅜-inch. Male, slightly smaller than female and with hind part of abdomen more strongly colored. Male also has sex combs on the front legs, although the function of these is not obvious nor easily demonstrated.	Length of some species, to 2 inches. Others to 1/5-inch long. Wings usually, although not always, held at right angles to body. Eyes, conspicuously large. Legs, long and large. Abdomen, slender. Some species may resemble bumble-bees, but are stouter and hairier. Thorax, considerably enlarged.	Under 1/3-inch long, bright metallic-green or blue abdomens. The males of some species with areas on the front legs that can be displayed in courtship. Other species have display organs on other parts of the bodies of the males. Legs, long. Antennae, short. Heads, small.
Family Rhagionidae. By some considered as the Family Leptidae. Seven species are listed from the genus in New York, and a half-dozen genera from the family in the same state. The flies are usually not very active, and may be found in abundance in low vegetation at times.	Family Bombylidae. A large family common in North America, where there are over forty genera and over 450 species. The hovering habit is a reasonably suggestive identification, and the animals commonly favor sun. They are not commonly found on leaves, usually favoring some other type of perch.	Family Drosophilidae. These flies are to be found in many species in many parts of the world. Commonly found about ripe and decaying fruit or plant tissues, or around spoiling fruit juices. Flies are frequently spoken of as sour flies, vinegar flies and pomace flies.	Family Asilidae. One of the largest families of flies, with over 500 kinds found in North America. Individuals are solitary and are commonly found perched on exposed stump or twig ready to pounce on passing prey, or to eat insects that have already been captured.	Family Dolichopodidae. A large family of flies with representatives to be found throughout the United States and most of Canada. Different genera favor different habitats, varying from water surface to the bark of old trees, as suggested below.
Larvae of snipe flies live in a variety of situations, some being found in water, some in burrows of wood-boring insects, some in moss or grass or other non-woody plants. Some contend that larvae feed on the bodies of their dead mothers in some related species and genera.	Larvae of the bee-flies are commonly found associated with other insects, some feeding on grasshoppers from eggs to adults, others on beetles, bees, caterpillars, wasps, some being even parasites of other insect parasites. They are practically all dependent in the larval stage on other insects.	At living-room temperature, eggs laid on fruits such as grapes or bananas, or on vinegar and beer, hatch in 2 days. Diminutive maggot larvae mature in 3 to 4 days and develop into pupae that are small, oval and, in fruit, last 4 to 5 days. Under ideal conditions a complete life cycle can be completed in 8 days.	Eggs usually laid on or under ground, or in damp wood, hatch into legless, worm-like larvae that feed on other insects found in rotting wood or in loose soil, under or in rotting leaves, or under rotting bark. Pupal stage spent in the ground most commonly without any special covering.	Males of many species show definite courtship display of special parts. Larvae of some species are predacious, while those of others may feed on decayed vegetation. Little is known of the life histories of American long-legged flies as contrasted with the European species.
In the related genus *Atherix,* the adults may crowd together and die in great numbers within a small area. Sometimes many bushels of the flies may be collected, and Indians have been known to prepare them for food. This does not, however, apply to the species or genus here figured.	Adults commonly feed on flower products such as pollen and nectar, which they may collect while remaining poised in the air before the food source. Except where the hosts are useful insects, the bee-flies can be considered as useful. Certainly they fill an interesting niche in the biological balance.	Food suggested above. Essential role is that of scavenger. Strongly sensitive to light, going towards it from darkened chamber. Known to carry *Aspergillus niger,* cause of smut disease of figs, and *Erwinia amylovora,* cause of fire blight of apples and pears. Reproductive powers are obviously enormous.	Food of larvae and of adults, other insects. Adults may be seen flying with huge insects held firmly, or may be watched while the meal is being finished. Are relatively unsuspicious and always interesting to watch. Never attack man or his domestic animals, although they may light on them rather frequently.	Sea-beaches often swarm with *Thinophilus,* while wet earth at water's edge has *Hydrophorus,* the water surface at edge of falls *Hercostomus,* the bark of tree *Medeterus* and *Neurigona,* old logs *Tachytrechus. Melanderia* is represented on the Pacific Coast.
There seems to be no record of serious damage caused by these flies to man, or to his crops or domestic animals. The adult of one genus in the family feeds on blood much as do horseflies. On the whole, these flies are probably essentially useful in terms of man's interests.	Bee-flies offer a challenge to entomologists and to agriculturalists charged with determining their economic importance. On the whole, they may probably be considered as useful organisms. No one can question that the animals are interesting to watch or to study.	Major use to man is in the study of heredity. Insects have superficial characters and variations that are transmitted to succeeding generations and make the study of many generations possible in a relatively short time. Also of some value as scavengers, as suggested above.	Economic importance depends on the insect prey selected. They have been known to capture honey bees, which are, of course, useful, but apparently they do not specialize on their prey as do many other animals. They are among the most interesting of insects to watch just for the fun of it.	These flies have probably been seen by every outdoor person in America and recognized by few, and yet few of them are well known even by the highly trained average entomologist. Since most of the adults probably prey on other small flies, they are probably relatively useful.

COMMON NAME SCIENTIFIC NAME	BIG-EYED FLIES *Dorilas atlanticus*	SYRPHID FLIES *Syrphus sp.*	FLESH-FLIES *Sarcophaga haemorrhoidalis*	CLUSTER FLY *Pollenia rudis*
DESCRIPTION	Exclusive of wings, the length is about 1/8-inch in most of these flies. Heads are conspicuously large and composed, apparently, almost wholly of eyes except for short antennae. Head is almost spherical and is wider than the thorax. Body is naked and sparsely haired. Wings at rest, parallel.	Small, prettily colored flies, with yellow-banded or black abdomens, some resembling honey bees rather closely, while others are more like wasps, being bare and flying awkwardly as do many wasps. Most are excellent fliers, a few buzzing or droning when in full flight.	Length, about 5/8-inch. Pale grayish-brown in general, with longitudinal darker stripes on the thorax and a checkerboard of dark spots on the sparsely hairy abdomen. Head relatively small, but eyes conspicuous and antennae inconspicuous. Wings at rest neither widely spread nor folded.	Slightly larger than a house fly but more sluggish, moving slowly and with wings held more closely together. Thorax, dark woolly with hairs. Abdomen, brown, with whitish spots. Space between the eyes white. When mashed makes a greasy spot and has a disagreeable odor.
RANGE AND RELATIONSHIP	Family Pipunculidae. A small family of some thirty species in North America, of which the largest is the type genus *Pipunculus*. Wings in all of the members of the family are longer than the abdomen. Flies are commonly found in shade, usually associated with flowers.	Family Syrphidae. In the family there are some 300 kinds of syrphid flies ranging through North America north of Mexico. Included in the relatives are the drone flies. Adults are usually found about fruits and flowers, particularly those on which aphids are to be found in abundance.	Family Sarcophagidae. A large, widely distributed family of flies of no small economic importance. Not so common in houses as are house flies but found there. The eggs and larvae are found in flesh, on dung, carrion, cheese, oleomargarine, pickled fish, waste, fresh fish, dead and living insects.	Family Calliphoridae. This is the blow-fly family. This species apparently introduced from Europe at an early, unknown date. Found commonly on sunny windows in fall and spring, or on the sunny sides of buildings in spring, or sometimes on snow or on the earth outside buildings.
REPRODUCTION	Larval stage of most members of the family live as parasites on bugs, but apparently the life histories of the group are not well known, as a rule. There is little evidence to indicate that the animals are scavengers in the sense that house flies may be.	Eggs of some species are laid among plant lice. When the eggs hatch, the larvae attack the plant lice, one having been observed to destroy 25 in as many minutes. Larvae are slug-like, to about 1/2-inch long, often with white stripes, commonly greenish, eyeless, flat, transversely wrinkled, and pointed in front.	These flies apparently deposit living larvae on the substance on which the larvae will live. As many as 20,000 eggs have been found in a single female, indicating the potentialities of reproduction. Pupation takes place after the larva has left its source of food supply.	Mate about February. Eggs laid on garden soil a month later, one laying as many as 97 an evening, hatch in 4 to 6 days into white, legless maggots that enter earthworms during mating and live as internal parasites about 3 weeks. Pupates in soil 2 to 6 weeks and winters as adult. Abundant when seeking hibernation.
HABITS	Adults may be found hovering about flowers in the shade, and may be seeking food or potential hosts for the succeeding generation. In spite of their small size, they are rather well known by observant naturalists because of the disproportionate size of the heads and because of the hovering habit.	Food of adults usually pollen. Five types of larvae based on food habits. Flat, green type feeds on plant lice; cylindrical type bores into plant bulbs; those with long tubes may feed in filth; those with short tubes may also feed in filth, and a short hemispherical type feed on insects in ants' nests.	Food of larvae and adults usually is filth. Among places in which larvae are placed in addition to those suggested are stomachs of frog, skin of turtles, vaginae of women who have been sun-bathing, wounds, stomachs of humans, under human eyelids, in living snails, in rotting vegetable material.	Food of larvae, earthworms; of 107 worms examined 74 supported 87 cluster fly maggots. Above temperature of 50° F. adults go towards light and avoid contact; below 50° F. avoid light and push against contact. In fall, then, they seek dark windows from outside only to reverse field and try to get out from warmer indoors.
ECONOMIC IMPORTANCE	Probably of little economic importance, at least in an obvious way. Since the larvae live as parasites of other insects, it may be assumed that some of them at least are useful as destroyers of harmful species, particularly when the favored group usually has a bad reputation so far as man's economy is concerned.	None of the group stings man. Larvae taken from foul water accidentally drunk by man may cause trouble and myasis. Most adults and larvae are useful destroyers of insects that are harmful to man's interests. Some larvae may burrow underground to feed on plant lice living on plant root systems.	Primarily scavengers suited to eliminating decaying organic material, but adults distribute filth and have been known to cause intestinal and skin myasis in man, to aggravate wounds and tumors. It is probable that the female is attracted by odor to a place suitable for the developing larvae.	May be annoying to housekeepers; may be considered as enemies of useful earthworms and as food for many insect eaters. Their close relatives the blue-bottle flies and screw-worm flies, of course, have dangerous habits so far as man's interests are concerned, but this species apparently does not harm man directly.

GREEN-BOTTLE FLY *Lucilia caesar*	STABLE FLY *Stomoxys calcitrans*	HORSE BOTFLY *Gastrophilus intestinalis*	DUNG FLIES *Scatophaga sp.*	LOUSE-FLIES *Lynchia americanus*
Like a small, greenish blow-fly with relatively large reddish-brown eyes that seem to monopolize the space of the head. Antennae, short. Wings, clear and held partly spread to the extent that they do not cover the abdomen to any considerable extent. Abdomen and thorax, distinctly metallic in appearance.	Length, from 1/4- to 1/2-inch. Gray, with darker mottlings. Eyes, reddish, with those of the male separated by a distance equal to 1/2 the head diameter, while those of the female are separated by 1/3 that measurement. Wings, clear. Mouth suited for piercing rather than for lapping.	Length, about 3/4-inch. Resembles a honey bee, but female has long abdomen bent forward beneath the main part of the body. Wings, dark-spotted, with those in the center forming an irregular cross-band; otherwise the wings are transparent. Wings seem relatively small for such a large-bodied fly.	*S. stercoraria* is approximately 1/2-inch long. The flies are usually rather slender, long-legged, commonly with yellowish hairs, with relatively small heads and small eyes and with abdomen appearing to be banded. The body is usually held rather high by the long-ish legs.	Yellowish-winged fly with the body flattened from above, the head small and closely attached. Antennae, relatively short. Eyes, conspicuous but not too large or joined. Wings, about twice as long as from tip of head to tip of abdomen. Legs, neither conspicuously large nor small.
Family Calliphoridae. A relatively large, widely distributed family that includes the blow-flies of the type genus *Calliphora,* cluster flies or buckwheat flies of the genus *Pollenia,* the screw-worm fly of the genus *Chrysomyia,* the large blue-bottle fly of the genus *Cynomyia,* and some parasitic flies.	Family Muscidae. This is the same family as that to which the house fly belongs. This species is common outdoors in warm weather, or indoors in muggy weather, and is recognized as the biting housefly. It is reported that these flies have brown wings when found near woodlands.	Family Gastrophilidae. Some authors consider the family name as Oestridae. It includes the gad flies, botflies, breeze flies and similar flies, in most of which the lower part of the head is relatively large, the eyes relatively small, and the mouth opening small. World-wide in distribution.	Family is called Scatophagidae by some and by others considered a part of the Calyptratae. Six species are found in a state like New York, and *S. stercoraria* (figured) is both common and widely distributed. The different species in the group have widely varying habits.	Family Hippoboscidae. The family includes a number of wingless flies such as the sheep tick, *Melophagus ovinus.* Some species retain their wings, others lose them, and still others never have any at any time. All of the members of the family are parasitic.
Larvae are to be found on carrion or in manure or even in garbage. The life history is probably completed in from three to four weeks, of which about half the time is spent in the larval stage. Of course, the life histories of the related species and genera depend on the food of the larva.	Eggs, about 1/25-inch long, placed on any moist substance, have distinct lateral furrow; hatch in 1 to 3 days. Larvae like those of house fly but found on variety of decaying substances, even decaying lawn grass; mature in 1 to 3 weeks. Life cycle may be completed in from 19 days to 3 months or more.	Yellowish eggs to 500 or more are laid singly usually on fore-knees of horses. These are licked off, hatch when moist, and larvae make way to stomach of horse where it develops for 10 months, molting twice and sapping vitality of horse. When mature, passes out in manure and pupates in ground 30 to 45 days.	Eggs are laid in cow dung, where the larvae develop much as do the larvae of house flies in horse manure. Eggs are laid when the dung is fresh and development begins early. Larvae of some dung flies in plant stems, while others develop as parasites of caterpillars.	In the related sheep tick, the larva becomes full grown within the adult female and is deposited on the host animal. Development from such deposition to adulthood takes approximately three weeks. It is probable that development of the young of this species is somewhat similar.
This species is known to carry the bacillus that causes lockjaw. An individual larva that had fed on infected meat has been known to develop into an adult that remained infected and a potential danger to human health for more than two weeks after the adult fly had emerged from the pupal stage.	Food of larvae is decaying organic material, but decaying straw in manure is favored. Winters probably in larval or pupal stage. It has the peculiar habit of biting most viciously before the beginning of storms. It is known to carry bacteria, protozoans and other organisms that may affect living things.	Food is obtained from the host horse by the larvae taking it anywhere from the intestines to the rectum, causing severe irritation and possibly serious illness. Other closely related species behave similarly in their host animals, the deer, squirrels, rabbits and other species.	Adult dung flies are commonly predaceous and may feed on insects as large as honey bees. The flies are relatively active creatures, as they must be to obtain food. A common trout fly is modelled to some semblance of this group of insects.	A number of species of *Lynchia* are hosts to the protozoan *Haemoproteus,* with different species being found in different hosts. This same genus of protozoan is found in some reptiles, some in mosquitoes and so on, but the transmitting organism may not be a louse fly.
Obviously this fly is a potential threat to the health of human beings and an enemy to our interests. It can be kept in reasonable control by screening potential breeding spots. Related species may be serious pests to live stock, among these being the screw-worm fly.	In 1912, Rosenau and Brues claimed to have transmitted poliomyelitis virus to monkeys by this fly. Control is by screening, by destruction of potential breeding places, by use of quick-lime on wastes, and by use of the newer insect sprays that destroy the free-flying adults.	Control is essentially spraying regions where eggs may be laid, chiefly on forelegs of horses, with a mixture offensive to the flies. This mixture may be offensive pine-tar and lard. Medicines are available that loosen the larvae and free them into the intestinal tract where they may pass out of the body.	Larvae are essentially of the scavenger type, while the adults, of course, may be considered as destroyers of other insects, some of which are useful, while others, of course, are not. Apparently they have no record as carriers of disease in spite of their association with dung.	*L. americanus* is commonly found on owls and hawks or on ruffed grouse. Related genera are parasitic on deer and other kinds of game mammals and birds. Some forms are winged until they find a host, and then the wings are shed.

(Continued from page 419)

her. Some of us cannot be so charitable of the situation. In the early days at Cornell, the new veterinary college had its barns some distance from the home of a professor of civil engineering. In a faculty meeting, the engineer complained that the veterinary college was a public nuisance, and offered as evidence the fact that he had marked some flies at his home and taken them to the veterinary college, only to find them later at his home. In answering the indictment, the professor of veterinary medicine commented in a strong brogue that, while he appreciated the careful studies in entomology made by the professor of civil engineering, he could not help but feel that if the flies deserted the veterinary college for the more inviting home of the professor of civil engineering "there must be a r--rr-reason." Tradition has it that the matter was dropped then and there. And so it is if we have flies, or if we do not have them, our knowledge of their control is such now that we can find a reason for their abundance in almost any place.

There is every reason to believe that flies appeared first on the earth in late Permian times, at about the same time as did the beetles. The grasshoppers, bugs and dragon flies had appeared earlier in the same period of time, with the cockroaches still earlier, and the wasps, caddis flies and some other groups in the Jurassic, much later. Still later in the Tertiary came the moths and butterflies, so our flies appeared about midway between the time the first insects appeared and the more highly evolved forms came into being. This of course was long before man put in his claim to mastery over the surface of the earth. If we must be philosophical rather than conceited, we must wonder if, after all is said and done, there is not considerable probability that when the last man has wiped out the last fellow man with an atomic bomb, or some other heinous product of his brain, somewhere, in some hidden crevice, there may not still be some flies ready to come out and again put in their claim for supremacy.

From what we have found so far in this insert, it is obvious that even if flies do eventually take over for us, it is quite evident that even then they will find themselves engaged in activities directed towards the destruction of foods that might help other flies survive, or towards the destruction of other flies themselves. One must doubt if removal of man from the pinnacle, and the substitution of flies, would tend to make the earth the home of one big happy family of organisms dedicated to mutual help. It does not seem to be in the cards for man to "live happily ever after," any more than it seems likely that flies as masters could establish a millennium. As Jane Ace used to say, "We must learn to take the bitter with the better and make the most of whatever situation presents itself." At least so far as our conflict with flies are concerned we should go down fighting. There is reason to believe that, in the geological past, flies have been an important factor in the elimination and extinction of some of the larger inhabitants of the earth. There is equal reason to believe that they will not find it so easy to wipe us out of competition. Certainly if we could learn to be selective in our control measures, and enlist the services of useful species in controlling those whose activities are competitive with ours, our task will be greatly simplified. We can well afford to direct some of our most intelligent efforts to this end. We cannot afford to let the flies win the battle through default on our part. We must aim to make the most of what we know, and not let valuable discoveries go unused, as was the case with DDT. We must not expect as yet perfectly selective control measures and must therefore demand that public servants in positions of power follow the most intelligent leadership available in undertaking control measures that may have wide influence. We must never forget that man prides himself on differing from other animals in possessing reason, and that the mere possession of that power cannot be accepted as an excuse for failure to use it.

Aesop is reported to have attributed to a fly the ability to philosophize like a human when he said, "The fly sat upon the axle tree of the chariot wheel and said 'What a dust do I raise!' " Another writer drew a dangerous simile when he said,

> "A convert's but a fly that turns about
> After his head's cut off, to find it out."

All of us have heard the sayings that "flies are easier caught with honey than with vinegar", that "even the lion must defend itself against the flies", and "to a boiling pot flies fly not". We remember the fairy tale about the meek little man who killed a large number of flies at one blow, and, on his reputation for killing large numbers, went forth to fight dragons and win fame and wealth for himself. As our understanding of the real role of these insects increases, we will find new uses for their activities, and new ways to defend ourselves against the damage they may cause. It takes only eight days to watch a fruit fly complete its life cycle, and only a few more to observe the story of other kinds of flies. It would seem that it would be worth our while to have everyone, at some time in his younger days, get a better understanding of the life history of some fly than we now have. With this understanding we can set the stage so that flies of different kinds must do what we want them to do, whether it leads to their extermination or not. We should give up chasing flies with fly swatters and, with suitable knowledge of their habits, regulate their activities accordingly.

We all know of the legend of the spider and the fly. With proper information we can, like the spider, invite flies to their doom with considerable success. Beelzebub was the god of the Philistines supposed to ward off flies. Zeus Apomyios was the Greeks' fly god. Similarly the Cyreneads worshipped the god Achor. I rather think that modern man is likely to put more faith in DDT.

★