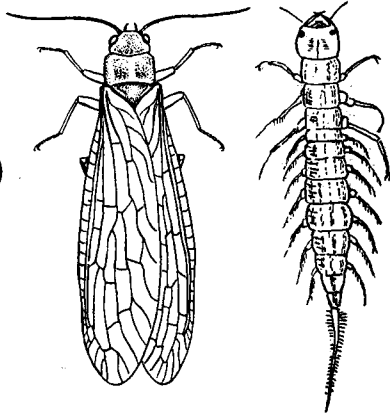


# Some More Water Insects

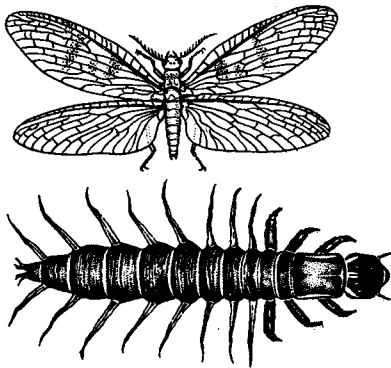
By E. LAURENCE PALMER

*Illustrations by the author, Ellen Edmonson, and Velma Knox.*

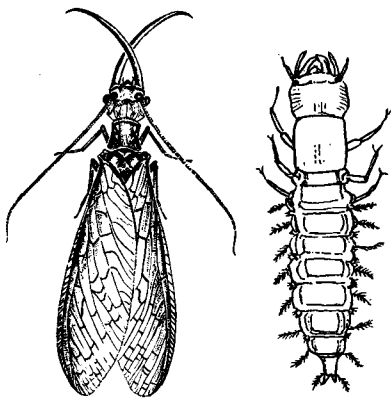
*This is the seventieth in NATURE MAGAZINE'S series of educational inserts.*



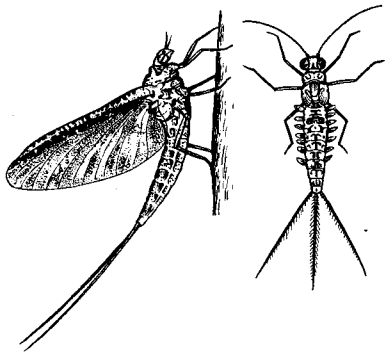
ALDER FLY



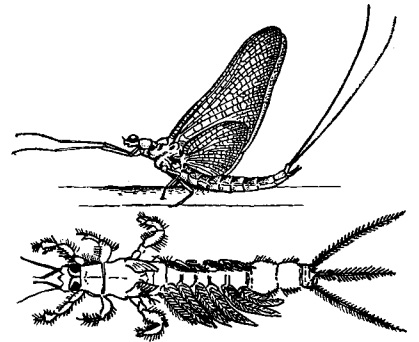
FISH FLY



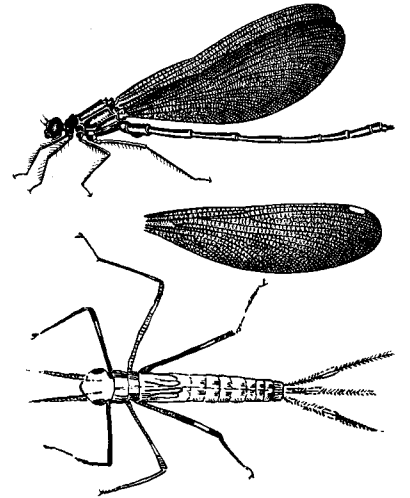
DOBSON FLY



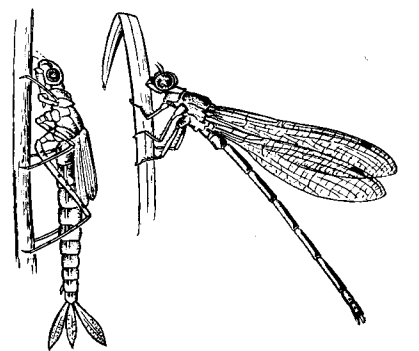
PALE GREEN MAYFLY



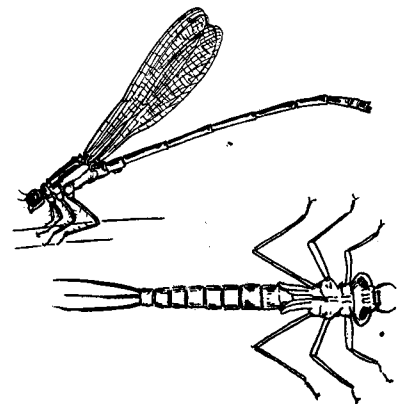
FELT FLY



BLACKWINGS DAMSEL FLY



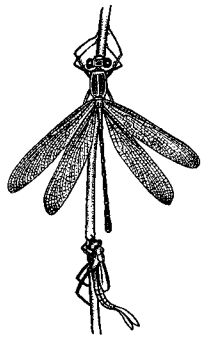
CHROMAGRION DAMSEL FLY



FORKTAIL DAMSEL FLY

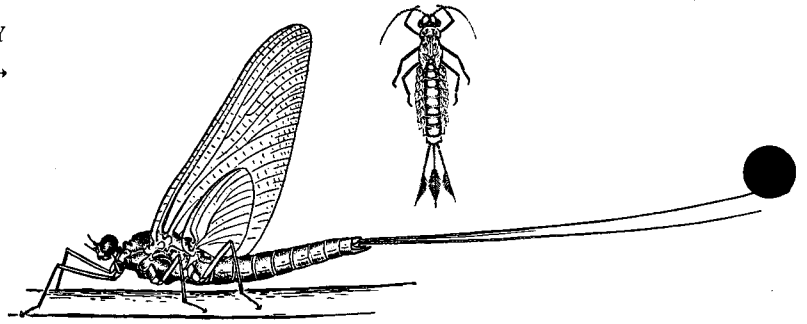
Do you like to shiver because of superstitions, to gloat over the possession of good fish bait, to read good Nature prose and even better Nature poetry? Do you like the comics? I like all of these things. I admit that some superstitions affect me more than others, that some bait is better than other kinds, that poetry and prose vary in their merits, and we might not agree at all on the comics. However, it is my choice of comics that led me to write this particular insert at this time.

I must be getting old, since few of my associates remember Billy Bounce, who amused me as a youngster, Petey Dink and a few others of those days. As a substitute for these fairy tales, and without losing interest in real fairy tales, I have in recent years got my fun from reading courses of study and textbooks for pre-college years written by persons who could not possibly have fished, rambled, photographed and enjoyed the kinds of things I assume are shared by readers of *Nature Magazine*. Just recently I have been reading a couple of new books that I have enjoyed thoroughly. In one of these, we see matching pictures of may flies and dragonflies. Beneath is the legend that tells us that the "larvae" of these insects feed on mosquito wrigglers and other forms of life, and the adults catch smaller insects as they dart back and forth in the air. It is because many youngsters will be exposed to this sort of statement that I elected this month to help you to know may flies and dragonflies and their associates better. Any experienced entomologist would have gagged at the assumption that adult may flies eat anything ordinarily, and would have questioned the implication about the food habits of the nymphs or younger stages of the may flies. May flies and dragonflies hold too prominent a place in my thinking and experience to let a statement like this one go unchallenged.



**RUBY-SPOT  
DAMSEL FLY**

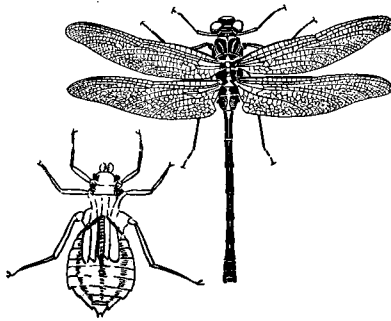
**SPRING  
MAYFLY**



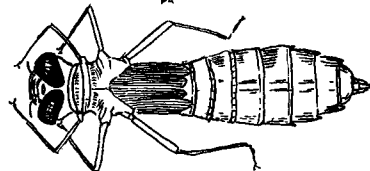
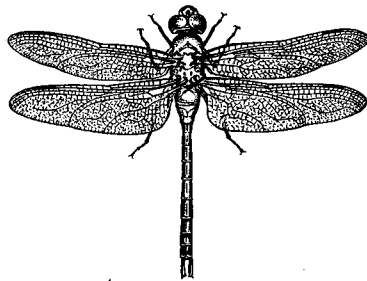
Have you watched a flight of may flies, seen a courting pair of dragonflies, or a hunting green darter? Have you watched dragonflies mate or lay eggs? Have you been frightened by dobson flies under a light or hellgrammites under a stone? Have you fished upstream when stone flies were emerging downstream? Have you read Benjamin Franklin's "To an Ephemera," or Tennyson's "The Two Voices?" True, Franklin missed the point, but I know of no prose writer who matches Tennyson's description of an emerging dragon-fly;

"Today I saw the dragon-fly  
Come from the wells where he did lie.  
An inner impulse rent the veil  
Of his old husk: from head to tail  
Came out clear plates of sapphire mail.  
He dried his wings: like gauze they  
grew  
Thro' crofts and pastures wet with dew  
A living flash of light he flew."

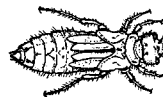
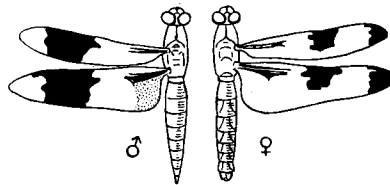
Some of our educators see no place for verse in a science course. Similarly I see no place for much of the prose they give us in a course of any sort. I make mistakes, plenty of them, some in these inserts, but I doubt if I can ever match some of the textbook authors who write for children. An introduction my third grade teacher gave me to Tennyson is something I wish other youngsters could get, even at the sacrifice of some of the "science" that is offered them. Had the writers of the particular text to which I have referred read the first of these inserts I would not have been stimulated by them to write this one. While the table showing insect orders in this book lists the group to which the dragonfly and damsel fly belong, it makes no mention in the table of the



**BLACK DRAGON**



**GREEN DARTER**



**WHITE-TAIL DRAGON FLY**



**TEN-SPOT DRAGONFLY**

(Described in insert # 1)

may fly or the other insects I featured in the first insert, and elaborate here.

At the risk of losing some of my audience I must begin this story with the statement that the insects here considered belong to four orders. The Neuroptera include the fish flies, orl flies and dobson flies. The Ephemera include the may flies. The Odonata include the damsel flies and dragonflies. The Plecoptera include the stone flies. I doubt if there is any reader who has ever been out in Nature much who has not at some time seen some of these creatures. Even in the largest cities may flies may sometimes be so abundant that they are swept up and carried off by the cartload. I have seen them darken the skies and street lights in the East and middle West, and I have watched some of these insects beside a wilderness trout brook.

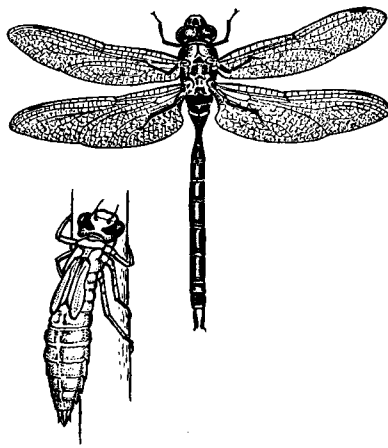
Within the group to which the fish flies, alder flies and dobson flies belong, we have such common and better known insects as the ant lions, whose larvae are sometimes called "doodle-bugs," and the highly useful golden-eyes, lacewings, or green flies. Some members of all of these groups are known in some way by most persons. The doodle-bug interests many youngsters. May flies fooled Ben Franklin, and while the adults rarely live over two days that does not constitute the complete life cycle, as Franklin implied in his delightful letter "To an Ephemera." Dragonflies of course rate high in the realm of superstition, doctoring snakes, sewing up noses and ears for the Devil, and generally making trouble. I doubt if there is anywhere a more interesting group of insects for the naturalist. The stone flies are ordinarily so self-effacing that they are not well known, but some swarm conspicuously over our early

spring snows, and a few may be considered as pests of fruit trees in some parts of the country.

**Food Habits.** The insects of these groups have decidedly varied food habits. Roughly speaking, however, the adults considered are not plant-eaters. Either they eat nothing, as is usually the case with the adult fish flies, dobson flies, may flies and stone flies, or they feed on other insects, as with the damsel flies and dragonflies. Despite what the high school biology to which I referred says, may flies do not dart about catching small insects. If they eat at all it is the exception.

Studies have been made of the food habits of adult dragonflies, and these show that they feed on other insects. They eat friends as well as foes of our agricultural products in about equal proportions. Taking dragonflies as a group, we find some most interesting food habits. Some, like the darners, of which we here present some examples, are strong, high fliers. Others, like the ten-spot, featured in the first insert, range around 15 feet above the ground. Neither the widow nor the white tail are high fliers. The damsel flies usually range lower than the more powerful dragonflies. Just as we apparently find that the different dragonflies seem to assume responsibility for different elevations, so we find that some stay close to a waterway, where they may lay their eggs, while others, like the powerful darners, can roam safely a mile or more from such a site. Then, too, there

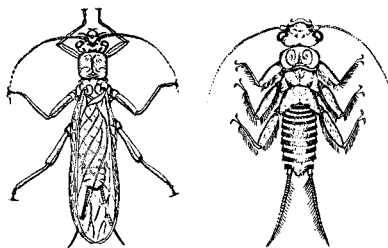
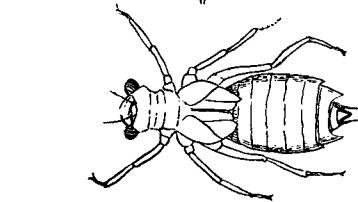
**WINTER STONE FLY**



**BLUE DARNER DRAGON FLY**



**THE WIDOW**



**THE STONE FLY (*Perla*)**  
(Described in insert #1)

is a responsibility of season that seems to have been established. Some range only at dusk or dawn, others only in strong sunlight. Still others roam about from earliest dawn to close to darkness. Some are early season dragonflies while others do not appear until fall, and some are active throughout the summer, spring and fall seasons where there is suitable open water.

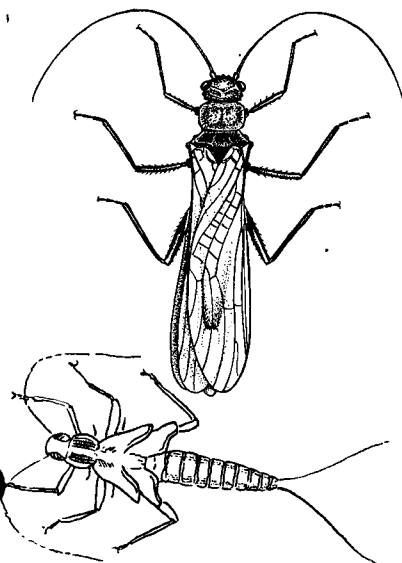
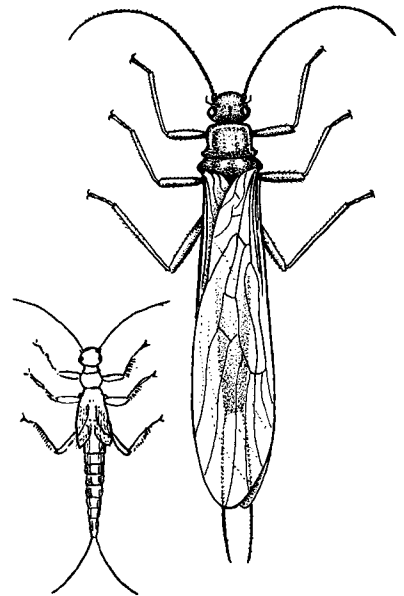
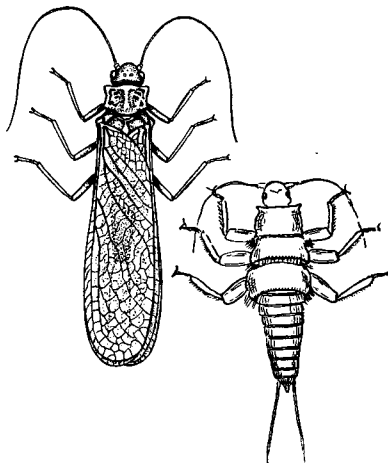
Except for a few of the stone flies, none of the insect groups here presented can be considered as insect pests of agricultural importance.

When we consider the food habits of the immature insects of these groups we have still further fun. The details of most of these are presented in the chart section, but I must emphasize that, for the most part, the immature may flies are out and out plant-eaters, while the immature stages of the other groups are largely animal eaters although many stone fly nymphs are plant-eaters. Certainly immature may flies do not feed to any extent on mosquito wrigglers. If you think they do, confine some in a tumbler aquarium and let me know the results. Essentially these may flies in their immature stages are the creatures that convert plant material into animal food that may be eaten by more powerful animal-eaters. They are to dragonfly nymphs, to dobson fly larvae, stone fly nymphs, and to many fishes, what cows are to us.

**How These Insects Move.** The adults of all of these insects fly. Flight however is a vari- (Continued on page 144)

**EARLY SPRING STONE FLY**

**LATE SPRING STONE FLY**



NAME SCIENTIFIC NAME	ALDER FLY, SMOKY ALDER FLY, HUMP-BACK, ORL FLY <i>Sialis infumata</i>	FISH FLY <i>Chauliodes pectinicornis</i>	DOBSON FLY HELLGRAMITE <i>Corydalis cornuta</i>	PALE GREEN MAY FLY <i>Callibaetis skokiana</i>
DESCRIPTION	Wing expanse 1 to 1-3/5 inches. Males somewhat smaller than females and hindwings shorter than forewings. Antennae about equal to body length. Body and wings black to rusty black. Adults probably live less than 3 days; prefer sunshine; do not eat; fly awkwardly. Harmless.	Length to wing tips over 2 inches. Wing-spread to nearly 4 inches. Female larger than male. Forewings gray with transverse yellowish streaks. Hindwings grayish. Hind part of head with yellowish flat streaks and spots. General color, cinnamon. Head wide. Antennae coarse.	Wing-spread to over 5 inches. Length to wing-tip about 3 inches. Sizes of sexes vary. Male with long, clasping jaws. Female with smaller, apparently more normal, jaws. Cinnamon brown bodies. Wings gray-white and spotted with little whitish dots. Head spotted and streaked with yellow. Legs brownish.	Total length of adult about 1 inch, with wing-spread of 4/5-inch. Pale flesh color marked and dotted with brown. Antennae and legs white. Male with 2 "tails" to 4/5-inch long. Female more yellowish with 2 "tails" to about 3/5-inch long. Subimago smoky brown with yellow on middle of fore-margin of front wings.
RANGE AND RELATIONSHIP	Found in adult stage near clear streams and lakes, usually active in daytime. Larvae burrow in bottom muds, sands or gravels of streams to depth of 1 foot. Pupae found buried under several inches of earth, sometimes some yards from the water's edge. Eggs laid at water's edge under protection. Family Sialidae. Order Neuroptera.	Found in and near fresh waters from New England to Florida and west to Michigan, Missouri and Louisiana, with related species extending the range. Considered with the orl flies and dobson flies as members of the Order Neuroptera, with all other members of the Family Sialidae. Nine species.	Family Sialidae. Order Neuroptera. Found often under street-lights where adults are attracted by light but usually not far from running water, whence they emerged. Quebec to Minnesota and to South Carolina, Missouri and Kansas. Adults do not fly well and are often found on ground.	Order Ephemeroidea. Family Ephemeridae. Ranges rather generally throughout North America. The genus is peculiar to the New World. Brown band on front of forewings more conspicuous in female is reasonable identification of adults. Adults seen floating on water with wings outspread while laying eggs.
REPRODUCTION AND JUVENILE STAGES	Adults emerge in spring, mate, lay eggs and, in a day or so, die. Eggs dark brown with white point, in clusters of some hundreds, hatch in about 10 days. Larvae as pictured grow to length of over 1 inch. Form pupal stage. Pupal stage lasts 2 or 3 weeks.	Adults appear about June, fly awkwardly, mate, lay eggs in masses of to 2000 over water. Eggs hatch in night, 5-6 days after being laid. Larvae live in water, probably over a year, or even 3 years, making a number of molts. Pupate some inches underground some feet from water. Pupal stage to 2 weeks.	Mate late spring or early summer and adults die in a day or so. Eggs laid in masses of to 3000 on supports, usually over running water; mass over 1 inch. Larvae live to 3 years in streams, reach to 3 inches, rough, dark brown, leathery looking, tufted gills. Pupate underground away from water 1 to 2 weeks.	Adults emerge through late spring and summer as subimagos or duns that live for 1 day, inactively, then shed skins to form imago or skimmers that mate, lay eggs and die usually in another day. Nymphs develop in about 6 weeks to about 1/2-inch at maturity and emerge, with several generations in a season. Females shy.
ECOLOGY	Larvae feed on other animals such as caddis fly larvae or their own kind. Pupae of course do not feed and larvae stay in water until ready to pupate. Adults of <i>S. nevadensis</i> reported, possibly erroneously, to feed on grape leaves. Larvae and adults superior food and bait for fish.	Adults probably eat nothing and die in a few days. Larvae feed on all small animals they can overpower, can be fed house flies, caddis flies, spiders and even own kind. Themselves serve as excellent food for fishes.	Adults probably eat nothing. Larvae feed on variety of aquatic animals, hitch along backwards, may bite viciously and at slightest disturbance, flattened, with gill tufts at side of each of first 7 segments. May be kept in cool boxes with wet vegetation or for weeks in cool cellar or longer in running water.	Food of nymphs is essentially plant material and nymphs are found active and alert among waterweeds and even algae that would entangle many other water insects. Make excellent aquarium insects, since can survive conditions commonly fatal to many other may fly nymphs. Move with "howdy" up-down body bending.
ECONOMIC IMPORTANCE	Excellent fish food, but probably destroy many other insects of fishfood value, and so may not be efficient in food cycle. May possibly destroy fish eggs and young fishes. Can hardly be raised efficiently for use and sale as bait as can crayfish, crickets and similar animals.	In some places larvae have commercial value as food for fishes, being used as bait. In some States certain streams are closed to harvest of these larvae, leaving them available as food for the associated game fishes and as sources for maintaining bait supply in other streams.	New York bait-dealers in one year sold 366,816 hellgramites, or consumption bugs, or dobson fly larvae, at \$8807.55 for use as superior bass bait, and some streams producing them are closed to collectors to prevent destruction. May destroy fish eggs and some young fish but on whole valuable as fish food.	Serve useful function as converters of plant material to food suitable for use by animal eaters. Particularly useful because of many broods that keep water well supplied with nymphs over a longer period than is common with many may flies. Subimagos may be identified in part by delicate hairs on spotted wing margins.

<p>SPRING MAY FLY <i>Blasturus sp.</i></p>	<p>LARGE MAY FLY EEL FLY <i>Hexagenia sp.</i></p>	<p>BLACKWINGS DAMSEL FLY <i>Calopteryx (Agrion) maculatum</i></p>	<p>RUBY-SPOT DAMSEL FLY <i>Hetaerina americana</i></p>	<p>CHROMAGRION DAMSEL FLY <i>Chromagrion conditum</i></p>
<p>Adults (Dun) dull brownish-gray with body ruddy or brownish, with browner rings at abdomen joints. Tail filaments 3, with the middle one about half the length of the other two whose length is about 1/2 total length of extended insect. Forewings about 2/3 length of longer filaments, held erect. Live only day or so.</p>	<p>Large may fly, the adult of which characteristically rests with pair of forefeet extended free of contact with support. Forewings about twice length of hind wings and terminal appendages of abdomen about 1/3 total length of extended adult. Possibly the largest of the may flies.</p>	<p>Adults. Male a brilliant beautiful uniform metallic green or blue on body with distinctly and conspicuously black wings. In the female the front of each forewing near tip bears distinct white spot but otherwise the appearance is similar to male. Abdomen is slender and wings seem loosely attached.</p>	<p>Length to 2-2/3 inches. Wing-spread to 2-1/3 inches. Copper bronze and metallic green with brilliant ruby spot at wing bases in both sexes. Wings otherwise more or less clear. Female has amber yellow at wing base instead of ruby, with more yellow on sides of thorax. Legs blackish.</p>	<p>Adult, length 1-2/5 inches. Wing-spread, nearly 2 inches. Blue and yellow. Wings clear with long narrow spot near tip to the forewing. Legs blackish. Top of head black. Segments 6 and 7 of abdomen wholly black. In male segments 8 and 9 of abdomen with round spots on blue background above, with dividing blue line above. Legs rather long.</p>
<p>Order Ephemeroidea. Family Ephemeridae. Found in or near fresh water ponds or streams in adult forms in May or June and as eggs or nymphs remainder of year. Apparently has no counterpart in Europe and is essentially American. May migrate from open water to stream or quiet pools in life time.</p>	<p>Order Ephemeroidea. Family Ephemeridae. Ranges through most of North America with adults emerging through late spring and summer. Nymphs to 2 inches long found burrowing in mud in shallows of fresh-water lakes, streams and bogs. They are more prone to be in slowly moving streams than in fast water.</p>	<p>Order Odonata. Family Agrionidae. Found usually close to ditches and streams that are small and near rocky woodlands, sometimes found along paths leading through woods to such streams. Flight is poor and so remain inactive except on good days suited to their needs. Season is April to September.</p>	<p>Order Odonata. Family Agrionidae. Ranges widely through North America generally, but commonly found in late summer season about streams and overhanging branches. Rarely found over a few yards from water's edge. May congregate in flocks of considerable size for a damsel fly. Males frequently rest on stones.</p>	<p>Order Odonata. Family Agrionidae. Known from Maine to New Jersey and west to Quebec and Indiana. Found for the most part on grasses and sedges near the edges of shallow pools, or as nymphs among vegetation in the pools. Not a ready flier and may stay for long periods of time resting on vegetation.</p>
<p>Eggs laid, probably in open water, develop into nymphs (brown quill of fisherman fly book) which reach length of nearly 1 inch boasting 3 equal "tails" and ruffle of gills along abdomen side, moving by "howdy" action bending body up and down; swim rapidly but may feign death if disturbed by removal from water.</p>	<p>Adults emerge in enormous numbers, swarm to lights, mate, lay eggs and die without eating after emergence. Accumulation of adults under lights near river towns may be 3 to 4 feet square and to 8 inches deep. There is no pupal or resting stage. Nymphs may mine way into mud banks but not for pupation purposes.</p>	<p>After mating the female, unattended by male, lays eggs in plant stems just below water surface. Nymphs showing whitish bands on legs and terminal filaments may reach length of 1 inch and may be found moving awkwardly in vegetation seeking other insects for food.</p>	<p>Adults appear about mid-July, mate, and female lays her eggs in soft plant material under water unattended by male. Nymphs live in moving water or rapids in shallows. Nymphs are brown or green without showy color pattern and reach length of 1 1/4 inches and move by sideways swinging of abdomen. Relatively slender. No pupa.</p>	<p>In late spring or early summer adults mate and lay eggs. The nymphs develop rather long narrow gills at end of abdomen but these taper sharply near the tips. After development among submerged vegetation, usually rather well away from shore, transformation takes place just above water in early morning or early afternoon.</p>
<p>Adults shed skins twice, the first stage being the subimago or dun stage, usually with dull wings and the second imago or spinners with glistening wings. Adults do not feed, despite what some high school texts say. Nymphs essentially plant feeders serving to convert plants to suitable animal food.</p>	<p>Nymphs burrow rapidly into soft muds and ooze, feeding on algae and diatomaceous stuffs and converting these plant materials into animal food suitable for consumption by larger animals including the fishes that are valuable as game. The Green Drake, Spinner or Coffin Fly of rapid trout streams is almost as large.</p>	<p>Both adults and nymphs feed on insects captured in flight by adults and by stalking in water weeds by nymph. Nymphs move by crawling, by sideways flexing of body and by forward thrust. Like other aquatic nymphs and adults of the group these damsel flies may be useful destroyers of mosquitoes.</p>	<p>Adults and nymphs feed on other small forms of animal life. Males known to be attracted to pink color similar to that in wing bases. Males apparently not shy and are easily captured. Females and males may assemble in groups of hundreds, the grouping usually beginning in the afternoon and lasting until next day.</p>	<p>Both adults and nymphs feed on insects and other small animals found in their vicinity. Locomotion in the nymphs is by sideways flexing of body or by crawling or by jet propulsion caused by ejection of water through rear of abdomen as in other damsel flies. Jaws of nymph, as in other damsel flies, extend with hinge.</p>
<p>Serve great role of the world, converting plants to animal food for animal eaters. May appear in enormous numbers during emergence season. Read Benjamin Franklin's "To an Ephemera" in his Autobiography, even though Franklin was misinformed regarding total life history.</p>	<p>Economic importance has been suggested above, but in some resorts are considered as pests. A type of hay fever sometimes results from fine scales of wings of swarming caddis flies but we do not know if this is also the case with these large-brooded may flies. Since wings lack fine scales it is doubtful.</p>	<p>Serve dual role in controlling multiplication of aquatic insects, some of which are noxious, but also serve as food for other animals including some common game fishes that may have access to the territory in which they live. Of course serve useful function in satisfying man's desire for beauty in nature.</p>	<p>Role in Nature much like that of other damsel flies and based on habit of eating other insects that may be helpful or harmful to man's interests. Transformation from nymph to adult takes place only a few inches above the surface of the water that has been left by the climbing animal.</p>	<p>Useful in two or more ways. Serves as control of other insects of the environment and as food for fish, insects and birds nearby. Nymphs and adults might be used as fish bait but more robust forms would be preferable in many ways. All damsel flies are interesting to naturalists, of course.</p>

NAME SCIENTIFIC NAME	FORKTAIL DAMSEL FLY <i>Ichnura verticalis</i>	BLACK DRAGON <i>Hagenius brevistylus</i>	GREEN DARNER <i>Anax junius</i>	BLUE DARNER DRAGONFLY <i>Aeschna constricta</i>
<b>DESCRIPTION</b>	Length to over 1 inch. Wing expanse to 1½ inch. Male and female show color differences. Males are green and black, with the 8th and 9th abdominal segments blue, with a black stripe down each side. At rest wings are held folded above the back as in other damsel flies.	Adult length to 3-1/5 inches. Wing-spread to 4-2/5 inches, making animal one of our largest dragonflies. Body stout. Legs long and black. Wings clear, long, powerful. Clasping organs short and blunt and rear of abdomen expanded. Eyes prominent and occupying over 2/3 the width seen from above.	Adult length to over 3 inches. Wing-spread to over 4 inches. Thorax green. Abdomen bluish. Face yellow. Legs black and reddish. Wings clear or yellow tinged. Abdomen pale at base. Best character of animal in flight is that of being greenish and large. Tireless flier and with gauze wings is a marvel of beauty.	Adult length about 2-1/3 inches. Wing-spread nearly 4 inches. Face yellowish. Thorax brownish. Legs black. Wings relatively clear but with small dark spots in front of the wing-tips. General effect bluish. Adults appear like husky insects and are capable of powerful flight high in air and at good distances.
<b>RANGE AND RELATIONSHIP</b>	Order Odonata. Family Agrionidae. Not commonly found over open water, but one of the commonest damsel flies in the United States to be found around swamps and waterway borders. Adults found through summer season active from dawn to dusk, but not found in great flocks like the may flies, midges and caddis flies.	Order Odonata. Family Aeschnidae. Ranges from Maine to British Columbia and south to Maryland and Texas. Individuals range rather far from breeding pond or other running water which it favors. Female may be seen laying eggs while in flight dropping to water at widely separated points freeing 10-20 eggs at a time.	Order Odonata. Family Aeschnidae. Ranges through most of North America where fresh-water breeding areas are available and even sometimes remote from them. Adult stage probably lasts only a few weeks. Color changes take place and at end body may appear almost hoary.	Order Odonata. Family Aeschnidae. Ranges from the Atlantic Coast west to the Dakotas with related species covering most of the continent. Strong, high fliers, being found sometimes miles from breeding area coursing high over grain fields and other open areas but returning to pools to place eggs.
<b>REPRODUCTION AND JUVENILE STAGES</b>	Mating takes place most commonly in June and July. Eggs are laid in water and hatch into nymphs that eventually reach length of 3/5-inch. Move by sideways switching of body, walking or darting forward by expelling water. Nymph stage may be long, over winter. Wing pads appear in later nymphal stages.	Mating takes place in flight preceded by erratic behavior. Female drops eggs in flight unattended by male. Nymph develops under water usually in trash on the bottom. May require a number of years in nymph stage. Transformation on logs or support near shore, on land but usually within a foot of water.	Mating is preceded by erratic flight. Male grasps female by neck region with tip of abdomen, and her body bends to meet his sex organs in thorax region. Eggs laid under water with female alone or accompanied. Eggs hatch in about 3 weeks from protecting plant tissue. Nymph immediately on its own.	After mating the female, unattended by male, lays eggs under water just below surface in plant stems. Eggs hatch in about 3 weeks and nymphs begin life of foraging among water plants for a living. Plan of attack is to remain stationary until prey approaches, then grasp with extended jaw, or may stalk prey first.
<b>ECOLOGY</b>	Both adults and nymphs feed on insects and other small animals captured by pursuit or stealth. Nymphs may fake death by lying on back in water if captured, but may suddenly come to life and spurt away by expelling water from gill area. Less limited in activities by light than are most damsel flies.	Food of adults and of nymphs, insects and other small animals that can be overcome. At no stage are they capable of harming man, or do they have mystic powers in helping snakes that are in distress. The adult animal is a thing of beauty at rest, or in flight, and as such if for no other reason should be protected.	Nymph stage lasts about 11 months during which there are molts of skin. It captures food by lying in wait, or stalking, and finally grabbing with extended lower jaw, which may have length of ¼ the body. Food is any animal small enough to be overpowered. Harmless to man.	Food of both nymphs and adults is animal life they can overpower. May destroy fish eggs or young fish, tadpoles and similar creatures. Insects caught in air are usually carried to resting place and devoured at leisure. Prey may be either useful or harmful to man's interests. Make good trout bait.
<b>ECONOMIC IMPORTANCE</b>	As nymphs and as adults prey on smaller animals, helping keep them in check. May be considered as fish food, and while some artificial flies are modelled after the fork-tail, the animals themselves are too small to be used practically in this way.	Of no great economic importance, probably. Nymphs may be used as fish bait but are not so suitable for this as are the nymphs of <i>Anax</i> and <i>Aeschna</i> , described in other columns. Nymphs might be harmful to fish nests and to young fishes, but adults are so beautiful that it is hoped they may be spared.	Excellent check on multiplication of small animals of environment. Nymphs may be 2 inches long and have commercial value as fish bait, with names such as perch-bug, bass-bug, what-is-it and dragonfly nymph. Nymphs can dart forward by expelling water rapidly from body jet propeller fashion.	Adults known as devil's darning needles, snake doctors and dragonflies but are probably essentially of neutral value. Are pleasing to the sight in rest or in flight. Nymphs known as bass bugs, what-is-its, and perch bugs. With other dragonfly species in one year in New York they had value of \$2837.69.

THE WIDOW DRAGONFLY <i>Libellula luctuosa</i>	WHITE-TAIL DRAGONFLY WHITE-TAIL SKIMMER <i>Plathemis lydia</i>	WINTER STONE FLY <i>Taeniopteryx nivalis</i>	EARLY SPRING STONE FLY <i>Allocapnia (Capnia) vernalis</i>	LATE SPRING STONE FLY <i>Pteronarcys dorsata</i>
Length of adult to nearly 2 inches. Wing-spread to 3-2/5 inches. Seems to be a blackish dragonfly with broad dark bands at the bases of all wings and body brown, striped rather inconspicuously with yellow, but in age upper part of body becomes bluish with a bloom.	Length of adult to nearly 2 inches. Wing-spread to 2 1/2 inches. Conspicuous differences in the sexes with wing patterns shown in illustration the male to the left. Notice also parallel sides of female abdomen and tapering tip in the male. Colors and spots change with age of individuals.	Length 1/2 inch. Slender, blackish brown with smoky wings rather transparent and equal length of body from snout to tip of abdomen. Antennae held to the fore and about, but not quite, equal length of body. Head narrower than thorax and rather squarish when seen from above. Wings overlap flat at rest.	Length of adults less than 1/2 inch, with males smaller and more slender than females, dark brown to blackish. Hind wings plaited or folded to lie under forewings when at rest. Terminal appendages of abdomen extend beyond the tips of the wings. Antennae held to the fore.	One of the larger stone flies, with the nymph measuring to over 2 inches and the adult with appendages exceeding that measurement. All stone flies have 2 claws per foot, as contrasted with 1 claw in may flies. In <i>Pteronarcys</i> the wings exceed the 2 terminal abdominal "tails" and hide them.
Order Odonata. Family Libellulidae. Ranges from Maine to Florida and west to North Dakota and New Mexico. Closely related Ten-spot, <i>Libellula pulchella</i> , was figured and discussed in the 1st insert of this series. The widow is especially common in ponds of the Mississippi Valley.	Order Odonata. Family Libellulidae. Ranges from Newfoundland to North Carolina and west to California and British Columbia. Characterized by being active, probably as long a season of the year as any dragonfly, with older animals graying with age.	Order Plecoptera. Family Perlidae. Found in eastern and central States of the United States, south as far as North Carolina. Found on snow or swarming on supports near swift water of fresh-water streams. Adults do not seem as alert as do the nymphs. Often abundant in great numbers in a locality.	Order Plecoptera. Family Capniidae. Only one species is to be found east of the Rocky Mountains, although several closely resembling it are found in closely related genus in northeastern North America. May be found crawling over snow like the closely related winter stonefly, <i>Taeniopteryx nivalis</i> .	Order Plecoptera. Family Pteronarcidae. Range includes territory from eastern States through Tennessee and Minnesota and north to Alaska. Territory in which they thrive is that of small creeks and rivers, where there is accumulated decaying plant material. Adults commonly found clinging to vegetation.
Mating takes place on the wing soon after emergence, which begins in May and may still be observed in September. Eggs laid by female, unattended by male, hatch into ugly looking nymphs, which live in muddy bottoms masked with silts and which may reach a length of 1 inch. Transformation usually on grass.	Females hiding among vegetation are sought by bolder males. After mating female, unattended by male, lays eggs in water, repeatedly dipping abdomen in water in flight at one spot, freeing 25 to 50 eggs at each dip. Nymph a squat, ugly looking creature that lives on bottom.	In northern part of range, from February through May, adults may be found emerging from water, where shed skins may appear in layers at water's edge. Adults mate then lay eggs in stream and die. Mating takes place away from water, but eggs are laid in water. Adults are short-lived.	Adults emerge from the nymph stage, leaving the water and taking to land from January through April in much of the range. Fly awkwardly or crawl upward and mate, after which females return to water to lay eggs. Eggs hatch into nymphs that may develop until emergence of next year.	Adults emerge in May and June and may be found emerging first in lower warmer stretches of the stream. Adults mate then lay eggs in the water. Nymphs develop from eggs and may require more than a year to reach maturity during which time they go through a number of molts naturally.
Adults and nymphs feed largely on insects. Adults are eaten by birds and nymphs by fishes. Ants kill many newly transformed adults, destroying their wings before they become completely expanded. Adults are not difficult to capture when they come to rest on grass stem or some bit of twig.	Food of adults and nymphs insects and other small animals caught in flight by adults, and largely by nymphs, by lying in wait on muddy bottom of waterway masked by muds on hairs, but ready to thrust lower jaw violently forward to capture a meal.	Adults do not eat, fly little, are probably more active in night than in day, and have tendency to keep crawling to higher and higher points, often crowding around tops of posts, stones or other structures they start on. Emergence is from stones, usually in swift water.	Adults are short-lived and probably eat nothing, even though they seem to have functional jaws on a superficial examination. Nymphs feed on plant and animal matter under water, and require water with high oxygen content. Show much disturbance if water is not fresh and cannot long live in aquaria.	Food is essentially plant material so they definitely provide a link between decaying plant material and the food needs of insect-eating animals such as fish. Trout feed ravenously on the newly emerged adults, so both they and the nymphs made good bait.
Insects of beauty, such as the adult widow dragonfly, should always be present to make a field trip a bit happier. If merely seeing the animal may be accompanied by witnessing courtship, mating or feeding and egg laying the experience is worth that much more. Nymphs in aquaria are also interesting.	Economic importance is probably small. Nymphs may be of value as fish bait, but are not so easily harvested as are those of the darners. Also because of their position on bottom are not as likely to be captured by their enemies and may remain a menace to young fishes longer.	Nymphs live on both plant and animal matter, thus turning these materials into other animal matter that is eaten by other insects and by fish. The members of this species are too small to be used as bait, but they are eaten by fish nevertheless. Emergence commonly in February.	Essential role is that of providing food for fishes by assisting in converting plant material to suitable fish food, even though they may also eat some other insects as well as the plants. Interesting because of their behavior in early spring.	Large enough to be put on fisherman's hook to catch trout. Trick usually is to collect insects downstream and then use them upstream, where emergence is to be expected and where fish do not long hesitate to take the bait for a meal.

(Continued from page 139)

able feat and in the dragonflies alone we have those that can soar to great heights, while other forms are much less able. Ordinarily we cannot consider that stone flies, orl flies, or dobson flies are superior fliers. They neither fly rapidly nor can they long sustain flight. This, in part, may be because they do not seek prey during their relatively short lives as fliers. The may flies, however, usually have even shorter adult lives and seek no food, and yet they sometimes seem to fly rather well. They cannot as adults match the dragonflies, whose lives depend on their ability to catch other insects.

The immature stages of these insects display a variety of means of locomotion, as you may discover should you keep them in an aquarium or seek them in the field. These means usually are modified by the type of water in which the animals live. Inhabitants of swift water vary from those that live in quiet water; burrowers differ from those that seek food in open water. To a considerable extent locomotion of the immature stages has been discussed in the chart section of this insert. If you wish to study this on your own here are a few points.

Many of the immature stages of these insects move by walking with orthodox legs. The burrowers, whether they are may flies or dragonflies, behave differently. The prowlers, like the nymphs of the darners, combine walking with jet propulsion, filling their rear parts with water and expelling it quickly so that they dart ahead violently. You may see this if you confine one of the nymphs in a shallow dish with mud or ink in the water.

Of great interest to many is the way the dragonfly nymphs are able to capture food without moving their bodies. If you will look at the lower jaws of these creatures you will find that they are strangely hinged. The jaw is doubled back under the head with two hinges, and the free end has hinged parts that make a formidable structure for grasping food. This jaw can be darted forward with lightning speed, and woe be a prospective meal that approaches the animal.

Catch a few larvae of the dobson fly, orl fly, or fish fly and observe their eating habits. Their jaws are really powerful. Notice, however, that some of these animals can give off a dark substance when they bite, while others do not. It reminds one of the "tobacco spit" of some grasshoppers.

Even the simplest motions of some of the immature stages of these insects are worth studying. Watch the motions of a damsel fly nymph and you will be reminded of the hip motions of some other damsels. Watch how the nymphs of may flies move their bodies up and down rather than from side to side. They seem to say "howdy" and some are spoken of as howdy may flies.

Notice the movements of the gills, or gill parts, in the immature stages of some of these insects. The position of the gills may give you a quick clue as to the identification of the animals. May fly nymphs commonly have their gills exposed along the sides of their abdomens and may have 2, or, more commonly, 3 "tails." Stone fly nymphs, on the other hand, may have the gills in patches

near the bases of the legs, or they may have them placed otherwise. They appear to have but 2 "tails." Damsel fly and dragonfly nymphs do not have gills exposed as they are in the may flies and in some stone flies. The damsel flies may show 3 tails, but they are usually broader than those of the may flies. In dragonfly nymphs these tails are reduced, as a rule, to short, stubby structures, and the animals may appear to be tailless.

To a biologist the story of reproduction of an organism is always interesting. Water insects are intensely intriguing in this respect. In the group to which the fish flies, alder flies and dobson flies belong we have the four stages that insect students consider as representing a complete metamorphosis. There is the egg, the larva, the pupa and the adult. In the may flies an almost unique system is followed. There is the egg, which hatches into a nymph whose function is to increase in volume. When the nymph is mature it emerges from the water and a most remarkable thing then occurs. What appears to be the adult stage is divided into two stages separated by a molt. We speak of the first of these stages as the sub-mago, or dun stage, and the second stage as the imago, adult or spinner stage. Usually the insects appear more glamorous in the second stage. In this second stage the insects mate and the eggs are laid. These two final stages may be completed in a 24-hour space, or they may last for two days. It is in this stage that the animals reach the climaxes of their lives. They fly. They breed. They lay eggs. For the rest of their lives they have merely eaten, or avoided being eaten.

In the dragonflies and damsel flies many interesting reproductive behaviors may be observed. You can see the females laying their eggs, either by repeatedly dipping the abdomen in the water at the same place while in flight, or by dropping the eggs at intervals. Or, again, we may find the male clinging to the female, even when she goes under water to lay her eggs.

The story of copulation is interesting because you can easily see the mated pairs in flight at times. The male commonly has grasped the sometimes duller female by the back of her neck with the end of his abdomen. In this position they may remain at rest or in flight for some time. When conditions are right the female brings the tip of her abdomen around to contact the region where the abdomen and thorax join in the male. Here the two join to produce the fertile eggs.

We could go on indefinitely telling you of the interesting stories of these insects, but the real function of these inserts is to start you to looking for things yourselves.

These insects are misunderstood by the laymen who have many superstitions about them. Not a few textbook writers ignore them completely, or misrepresent them, as I have indicated earlier. In few, if any, cases are they of major economic importance directly, but without may flies the raising of fishes would be a complicated problem, so they have some importance. There are many other angles that might be presented, but with this we will wish you luck and understanding in your future relation with these often misunderstood insects.