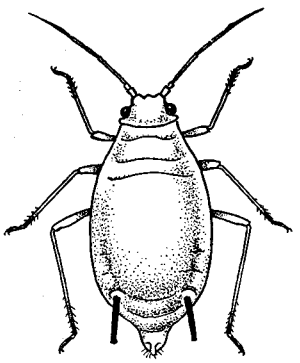
"Bugs"

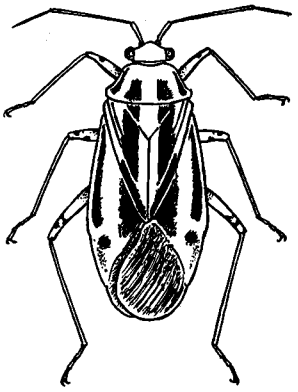
By E. LAURENCE PALMER

Illustrated by Ellen Edmonson and the author

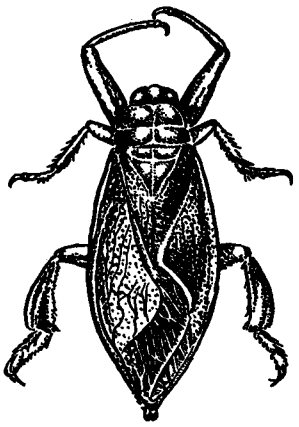
This is the seventy-second in NATURE MAGAZINE'S *series of educational inserts.*



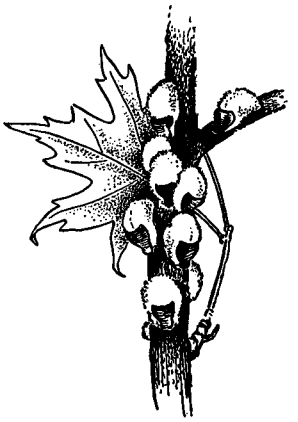
MELON APHID



FOUR-LINED PLANT BUG



GIANT WATER BUG



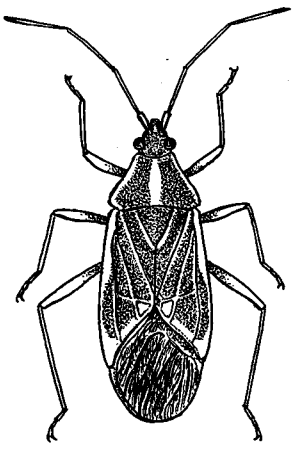
COTTONY MAPLE SCALE

FIFTY-FIVE years ago this summer I was a ten-year-old youngster having my first experience with cyanide of potassium. I had read in a Cornell University bulletin about making a cyanide jar in which to kill insects. I remember distinctly buying the poisonous stuff at a drug store, the entrance to which was marked by a wooden Indian and two huge bottles of green and blue liquid. Why the druggist was able to sell it to a ten-year-old boy I shall never know, but he did, and I added some plaster of Paris to the cyanide in the bottom of a Mason jar and soon had a killing jar for my insects.

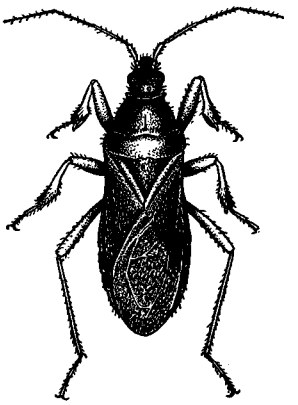
I made a crude collecting net attached to a loop of haywire nailed with great difficulty to a hardwood broom handle, and went collecting insects in a field where now stands the imposing structure of the Cortland, New York, State Teachers College. The first insect I caught I now know was a palmerworm, but I did not know it at the time. Instead, after mounting it, according to directions, with other insects that went into that bottle, I pinned it with great care in a section of a huge, black, pasteboard box. On the outside of the box, with much wobbling of the paint brush, I inscribed the word BUGS in large white letters. To me then, and to many persons now, all insects were bugs. I believe that with a little trying I could name most of the insects that I mounted in that first box, which was the forerunner of a series of cigar boxes that made a stack at least three feet by four feet. Each of these boxes was packed full of pinned insects and eventually each box came to be filled with related insects, so that there were some beetle boxes, some butterfly boxes, some wasp boxes, and, of course, some bug boxes. I think that most of us learn many things this way. We begin with a conglomeration of things, and sooner or later, in self defense, we begin to put similar things together.

"Bugs" is not a generic name that may be applied readily or properly to all insects, any more than "insects" is a generic name that can be applied not only to insects but to spiders, scorpions and other arthropods. In my *Bible* dictionary, I find scorpions and spiders listed as insects. There, also, I find beetles listed as species of locusts, although what a locust may be is difficult to determine. Is a locust an hemipterous insect, or an orthopterous insect? I fail to find bugs of any kind listed in my *Bible* dictionary, but it is difficult to believe that these creatures did not enter the lives of persons who lived to the east of the Mediterranean. Possibly some of my readers can help me, as they have in the past, to find Biblical references to insects that are really bugs.

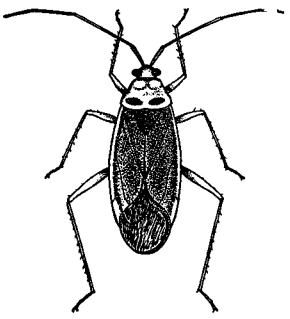
At this point you may ask me what I mean by a "bug." When I first studied entomology in college I was told that members of the Order Hemiptera were "bugs." By the time I finished my college training, the Order Hemiptera had been



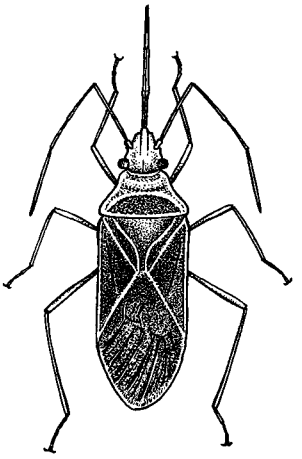
BOX-ELDER BUG



KISSING BUG



COTTON LEAF BUG

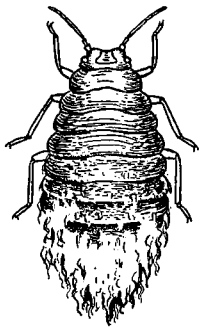


COTTON STAINER

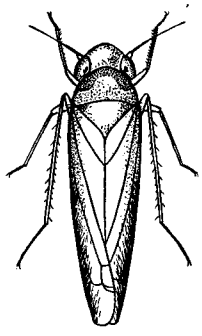
divided into the Orders Hemiptera and Homoptera. I admit that in this insert I have stuck to the old classification, and, as shown in the chart section, have included examples from each group. A glance at the sketches will show that some of these insects, like the box-elder bug, the kissing bug and the giant water bug, seem to have wings that are partly membranous and partly otherwise. These half-wings are in the Hemiptera. The leaf hoppers, aphids and scale insects, which we include as bugs, do not have the half-and-half wings and are considered as members of the Order Homoptera. Members of both groups, however, have sucking mouth parts, and do not go through the larval, pupal and adult stages of such insects as the beetles, flies, butterflies and wasps. Instead, the bugs have what we call an incomplete metamorphosis in which the young stages have at least some resemblance to the adults, usually differing primarily in lacking the full wings of the adults.

In a popular sense some use the term bugs, as when speaking of June-bugs. These insects, of course, are beetles and not bugs. We also speak of being as "snug as a bug in a rug," but whether we refer here to a carpet beetle, or a clothes moth, or maybe a bedbug we do not know. Certainly there are plenty of insects to be found in rugs and not all of them are bugs in the strictest sense. While in our vernacular we put bugs in rugs, ants in pants, and bees in bonnets, we really are not so free in our use of the word bug as we are in use of the word "fly." A "fly" may be, in popular terms, almost any kind of insect. From May-fly to a dragon fly, from a caddis fly to a syrphid fly, from a Spanish fly to dobson fly, we have insects none of which are flies. It is not so easy to find the term bug used erroneously as it is to find abuse of the word fly. A mechanic likes to let an engine run for some time until it gets the "bugs" out of it. When we want to make a suggestion to a friend we may put a "bug" in his ear. When someone goes insane we say that he is "bug house." It is quite probable that in the vernacular the word bug is ordinarily not associated with something that is good. On the contrary it usually suggests something that is undesirable.

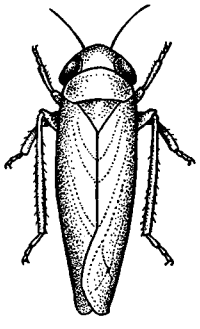
The Geography of Bugs. A glance through the second section of the chart material on bugs in this insert will show that these insects vary in their distribution. Some are relatively limited in their range, while others use most of the whole world as a feeding ground. Where their food organisms are few there is obviously a tendency for the species to be limited to the range of the food. We do not find many enemies of orange trees in the northern States. A glance at the section dealing with food and ecology



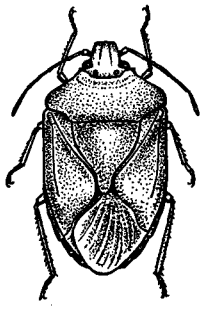
WOOLLY APPLE APHIS



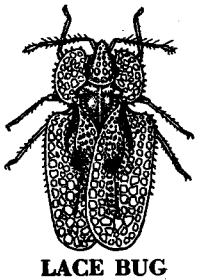
APPLE LEAF HOPPER



BEET LEAF HOPPER



GREEN SOLDIER BUG



LACE BUG

may also be helpful in showing how the range of different bugs may vary. A study of this material will show repeatedly that many bugs may have alternative hosts that they use at different times of the year. Beet leaf hoppers, for example, may winter on Russian thistle, but they move into the beet fields when those crops become available. Other bugs have similar stories, and an appreciation and knowledge of this may be important in managing control. If the alternate hosts can be removed the chance of survival for the bug is naturally decreased.

Just as there are variations in the great geographic range of our bugs, so there are equally definite limitations to be found in any given area. Giant water bugs naturally feed in water where they can swim readily and can capture their favored food. Other insects will favor drier spots, warmer spots, shadier spots than their kin. In the notes on grape phylloxera it is shown that one method of controlling these destructive insects on the roots of grape is to flood the vines and drown the insects while they are underground. On the other hand some bugs may be controlled by removing water entirely from their environment.

Other Bugs in Other Inserts. There may be those who will say that we have not necessarily selected for inclusion here some of the commoner, better known bugs. Chinch bugs, squash bugs, bedbugs and so on do not appear in this insert. As a matter of fact the first insert of the series included such bugs as water striders, water boatmen, water scorpions, smaller giant water bugs among the water insects. We did not like to repeat treatment of them here. In addition to these just mentioned we have seen fit in these inserts not to include ordinarily organisms that are included in Palmer's *Fieldbook of Natural History*, published by McGraw-Hill Book Company. Adding the eighteen bugs here included to the twenty included in the fieldbook, we have thirty-eight bugs handled in this way. The fieldbook bugs, not mentioned in this paragraph or in this insert, include oyster-shell scale, citrus mealy bug, rosy apple aphid, pear psylla, rose leaf hopper, buffalo tree hopper, spittle insect, seventeen year cicada, tarnished plant bug, meadow plant bug and gray damsel bug.

Bugs, Health and Economy. Many bugs are annoying and some really dangerous to man. Riley and Johannsen's *Handbook of Medical Entomology* gives a considerable list of bugs that have been known to bite man. Some of these are included in our insert—the giant water bug, the kissing bug or assassin bug, and even the tarnished plant bug and the apple leaf hopper. The bedbug, of course, is probably the worst known offender in this category. The Chagas'

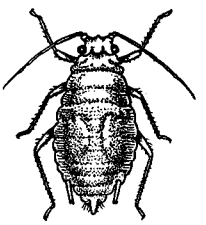
disease, which is often fatal, is carried by the bite of a relative of our kissing bug. In Asia a type of recurrent fever is carried by the bite of bedbugs.

Our bugs have a worse record when we compare their relation to plant health with their relation to animal health. Aphids, leaf hoppers and white flies are the major carriers of virus diseases of plants. Many of these virus diseases cut down the production of the plants enormously, and, in some cases, completely destroy crops. Because of this the economic importance of these insects may be more than that of many species whose only injury to the plants is that which they themselves inflict. Of course, a crop may fail because of a virus introduced by insect injury, or because of an attack of a fungus plant that was able to thrive because the plant was weakened by insect injury. The point is that no one can deny that bugs do wreak great havoc on plants that are of food value, and, therefore, insects are of economic importance to man. Economic entomology has an important place in world economy, and much of economic entomology concerns itself primarily with the control and management of bugs. Chapter 12 of John Charles Walker's *Plant Pathology* should prove informative reading to those interested in some phases of this problem.

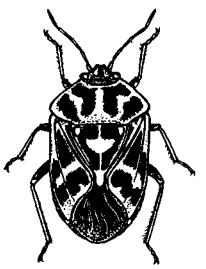
Of such economic importance are insects that the 1952 Yearbook of the United States Department of Agriculture is devoted to a consideration of them and the problems they create. These yearbooks are printed in limited editions, and it is not likely that another number on insects will appear again in the relatively near future, so it is a valuable work to consult or own. It is in part because of the appearance of this book that this special insert was prepared.

How Bugs Eat. One of the reasons why bugs manage to do so well by themselves is on account of the way in which they eat. We may cover a plant with a poison that would kill a beetle or caterpillar that chews its food, but it would have no effect whatever on the bug that merely thrusts its piercing mouthparts through the covering of poison and sucks the plant juice that serves as its food.

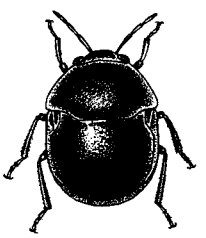
These piercing mouthparts of bugs vary considerably with the kind of food eaten. If some of the insects must feed on the seeds of cotton buried beneath cotton fiber, and enclosed in a leafy covering, the insect must be able to penetrate this cover in order to eat. If the food is an active fish, a bug like a giant water bug must be able to capture and hold to the fish and pierce its skin to get at the juices that are to be food. If the insect feeds on the juices of a woody plant it must be able to penetrate the bark and wood of the stems or roots on which it feeds. To do this some bugs, like the cicadas, must make their way through closely packed earth for considerable distances. Once they have tapped a source of food they may settle down and gorge themselves for a long time. You can read the story of some of the scale insects to understand some of this.



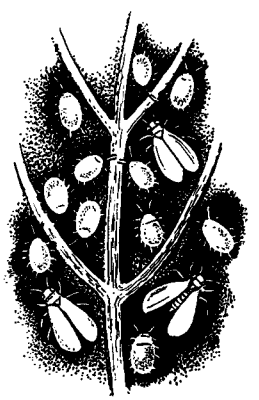
GREEN BUG



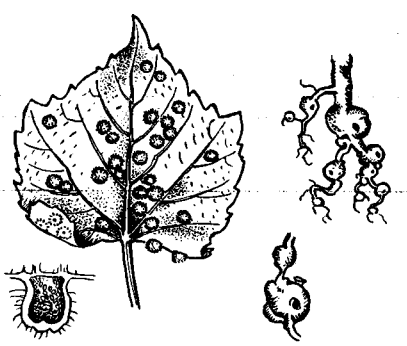
HARLEQUIN BUG



NEGRO BUG



GREENHOUSE WHITE FLY



GRAPE PHYLLOXERA

Since many bugs move from one food supply to another between meals, they may help spread virus and some other diseases of plants. Some may do the same with animals, although fortunately this is not common over much of the United States among the animal disease carriers.

How Bugs Breathe. Bugs breathe through pores in the sides of their abdomens. It has been found that if one cannot kill bugs by means of poisoning that they can kill them by preventing them from breathing. Commonly this is effected by using a spray containing soap or oil, or some similar substance that forms a film. If the breathing pores of a bug are covered with such a film the bug cannot get air and so becomes strangled and dies. The problem with this sort of control is to get the spray where it will do the most good and yet prevent it from interfering with the plant, which itself may need air. Since a bug's egg may not need air, as do the other stages in the insect's life, it would be possible for a bug to lay an egg and then die. Some time later the egg would hatch and the new bug would take up where its parent left off. To care for this situation it is common practice to make periodic sprays, one of which will kill the adults and nymphs and the next of which will kill the nymphs that came from the eggs that were left.

Some of the water bugs have interesting ways of breathing. This is particularly true of the water scorpions, which can breathe through a long tube at their rears. These bugs merely extend this tube like a periscope, or snorkel, above the surface of the water and continue to explore under water for the insects on which they feed. Most other water bugs that live under water get their air supply from the rear, leaving their food-getting apparatus free to explore the depths. Most of them get a reserve supply and take it under water with them rather then continuing to breathe through a periscope-like device.

How Bugs Move About. We (Continued on page 368)

NAME SCIENTIFIC NAME	NEGRO BUG *Corimelaena pulicaria*	HARLEQUIN BUG *Murgantia histrionica*	GREEN SOLDIER BUG *Acrosternum hilare*	BOX-ELDER BUG *Leptocoris trivittatus*
DESCRIPTION	Length, about 1/10-inch. Beetle-like in superficial appearance. Hard-shelled, shining black, broader to the front. May rest with legs and other appendages hidden beneath upper parts. May appear in great numbers crowded together in a small area, sometimes appearing like the droppings of other insects.	Length about ⅜-inch. Foul smelling. Flat and shield-shaped, with many gaudy red and black spots formed usually in a bi-symmetric pattern. In adult, wings, when folded, cover 2/3 length of body including the head. Antennae about equal in length to front legs. Adults broadest towards the front.	Length to ¾-inch. Stout green bugs with free tips of wings showing as membranes only 1/3 length of body. Broadest at forward end of abdomen. Edges of head, thorax and abdomen bordered with yellow or red. Last nymph stage ½-inch long, with head and thorax black and orange and abdomen yellow green.	Length about ½-inch. Brownish black with 3 longitudinal red stripes on the thorax and with red veins in the wings. Flat-backed and narrowly oval in general outline and generally rather neat in appearance. The abdomen under the wings is bright red. Known as democrat bug and populist bug in Kansas and vicinity.
RANGE AND RELATIONSHIP	Order Hemiptera. Family Cydnidae. Found throughout United States and Canada east of the Rocky Mountains. Common on cereal plants such as corn and wheat, and particularly on celery, raspberries and blackberries; on many ornamental flowers, veronica, lobelia and Bidens, and on many weeds. Erratic.	Order Hemiptera. Family Pentatomidae. Essentially a southern insect ranging from Atlantic to Pacific, but rarely in destructive abundance north of 40th parallel. Spread over South from Mexico shortly after Civil War and was believed to have been brought in by Yankee troops.	Order Hemiptera. Family Pentatomidae. One of a large group of destructive bugs. Sometimes listed as *Nezara*. This species ranges throughout the United States and Southern Canada, south to West Indies and Brazil, and in some parts of its range is a serious pest of fruits.	Order Hemiptera. Family Coreidae. The squash bug of the garden belongs to the same family. Box-elder bugs are most abundant in the middle West, particularly where the box elder is to be found in abundance. It may feed on the leaves of ash, maple, or even of some houseplants.
REPRODUCTION	Winter as adults. Eggs, laid singly on leaves, hatch in about 2 weeks into reddish nymphs that resemble adults. Increase in size by molts and by midsummer reach maturity. Breed and feed a few weeks in midsummer, but enter hibernation before any cold weather appears.	May feed and breed throughout the year. May emerge from hibernation with earliest warm weather. Lay tiny, white, keg-like eggs in bunches of about a dozen in double rows on under side of leaves. Eggs hatch in 4 to 20 days and, after 5 stages of development, reach maturity in 4 to 9 weeks. 3-4 generations a year.	Winter as adults, emerging in May. Light yellow to light green eggs laid in clusters of to 50 on leaf. Female lays 2 or 3 batches. Eggs hatch in 1 week and first stage spent near hatching point. In development passes through 5 stages getting wings in the 5th. Mature in 7 to 10 weeks. One generation.	There is one generation, or sometimes two, a year. Adult females that survive winter lay eggs on box-elder leaves in early spring. The immature nymphs are bright red. In late summer and fall reach greatest abundance and then congregate in great numbers, seeking hibernation spots, at which time they may crowd into houses.
FOOD AND ECOLOGY	Secretions of insects give foul taste to raspberries and blackberries, and hosts of insects on many crops suck juices and cause plants to wilt and die, sometimes destroying thousands of dollars worth of celery, for example in Ohio. Insects usually crawl rather than fly. Wings hidden under enlarged shield on back.	Particularly favor asparagus, cabbage, cauliflower, collards, Brussels sprouts, horseradish, kohlrabi, radish and turnip, or, as alternative food, tomato, okra, potato, eggplant, bean, beet as well as almost any garden crop, field crop, fruit tree, or weeds such as wild mustard and amaranth pigweed.	Attacks many plants injuring peach, apple, pear, cabbage, beans, peas, okra, tomato, eggplant, corn, turnip, mustard, cotton and many trees, shrubs and herbs. Because of wide range of food plants is difficult to control. Hibernation is under trash and leaves, usually where it is dry and sheltered.	Cannot injure man or beast by biting, but do have considerable nuisance value when they crowd into houses where they may be crushed against valuable fabrics, or on wall paper, window curtains and the like. May show some response to heat and light. Nymphs may sometimes be injurious to strawberries.
ECONOMIC IMPORTANCE	Control by destruction of infected weeds. Nicotine sulfate spray using 8 pounds of soap with 100 gallons of water to 1 quart of nicotine sulfate. This will kill the bugs hit by it. Fortunately the bugs are not ordinarily common, but unfortunately when they are abundant they may be highly destructive.	May be destroyed by hand picking early in the day, or by dusting with 10% DDT or toxaphene at about 40 pounds to the acre, or by using 2 pounds of 50% wettable DDT to 100 gallons of water, but these must be used before parts useful to man as food have begun to form. In these stages use rotenone dust or spray, or 20% sabadilla.	Contact sprays and hand-picking are the best means of control. The insects are a bit sluggish in movements and are inclined to hide much of the time. They may injure cotton bolls, causing them to shrink and decay, and, of course, ruining the fiber and the crop.	Control is essentially that of spraying insects when congregated in houses or other hibernating spots. In houses the usual insect sprays are effective. In the outdoors kerosene may be used, or use 1 tablespoonful of 40% nicotine sulfate in 1 gallon of water, into which 1 ounce of soap has been dissolved.

COTTON STAINER *Dysdercus suturellus*	LACE BUG *Corythuca ciliata*	KISSING BUG *Melanolestes picipes*	FOUR-LINED PLANT BUG *Poecilocapsus lineatus*	COTTON LEAF BUG *Calocoris rapidus*
Length to 3/5-inch. Flattened, narrow, long-legged. Head and prothorax bright red, with remainder of body dark brown with light yellow lines running crosswise. Folded wings in adults cover the abdomen. Adults with long sucking beaks, which can be inserted between leaves that usually protect a cotton boll.	Length about 1/8-inch. Conspicuous because of lace-like wing covers and lace-like expansions at the sides of the front part of the insects, with legs and antennae extending beyond edge of "lace" when viewed from above. There are dark mottlings, which add to the lace effect in making these small insects relatively conspicuous.	Length to 1 inch. Head small, narrow, conical. Wings crossed flat on the back and when folded come to abdomen edge, which is extended at the sides into thin plates. Dark brown to black with some pinkish or reddish-brown bar-like markings. Legs and antennae, long and slender.	Length to 1/3-inch. Greenish-yellow with 4 distinct black stripes down the wingcovers on the back. General outline oval with relatively long legs and black antennae. Very active. Nymphs are bright red to orange, with black dots on thorax, and in last stage with yellow stripe on wing-pads.	Length to just over 1/4-inch. Relatively slender with wings of adults covering over 3/4 of the length of the body. Legs and antennae relatively long. There are distinctive bright red spots near the middle of the wings when at rest. The nymphs are bright green with conspicuous red markings.
Order Hemiptera. Family Pyrrhocoridae. An important cotton pest in Florida and found in some numbers in Georgia, Alabama and South Carolina, but not in large enough numbers to be considered a serious menace. While main food is cotton the insects are also found on other plants.	Order Hemiptera. Family Tingitidae. Some 70 species in Subfamily Tinginae range over eastern States, each being confined to relatively few closely related hosts. *C. ciliata* the sycamore lacebug has been found on ash, hickory and mulberry, as well as being most common on sycamore.	Order Hemiptera. Family Reduviidae. One of the assassin bugs or masked hunters closely related to Mexican bed bugs and so-called China bed bugs and to the masked bed bug hunter. Many of the group frequent dwellings and outhouses. They are more abundant in the South and Southwest.	Order Hemiptera. Family Miridae. A member of a large family of plant-bugs with tarnished plant-bug one of the better known close relatives. It is relatively common throughout area east of the Rocky Mountains, living on many plants, both wild and cultivated, and sometimes being a pest.	Order Hemiptera. Family Miridae. The family is known as the leaf-bug family and is probably one of the families with the largest representation of the Hemiptera in America. Included in the family are the tarnished plant bug, tne red apple bug, the hop red bug, the false red apple bug.
In fall and winter insects congregate in great numbers on piles of cotton seed to hibernate there, or on rubbish. Eggs are laid on plants in early season and the nymphs, that may average 1/3-inch long and show small wing patches, develop to reach adulthood and greatest abundance by August and September.	Winter is passed in hibernation in adult stage. Eggs laid along ribs on under leaf-surfaces in early spring, hatch in 2 to 3 weeks, and in 5 to 6 more weeks develop to mature stage. In the North there are two generations a year and in the South and Southwest there are more. Eggs, cast skins and excrement abundant.	Short-winged adults that appear in the fall hibernate through the winter and, in the Kansas latitudes, become active under trash and stones by April and May. Apparently there is but one generation a year and it follows the ordinary pattern of insects of tnis general type.	White eggs placed in slits in canes of currants and similar plants. Several eggs in one spot but ends stick out. Hatch in May or June into bright red or orange nymphs that reach maturity in about 6 weeks, with one generation a year the rule. Female lays eggs in the fall and may die.	The life history is not well known, but there are several generations a year apparently, and the pattern is undoubtedly similar to that of other members of the family here described. Wing patches appear in the later nymph stages but do not cover half the abdomen in nymphs.
May thrive on cocklebur, nightshade, hibiscus and at times may attack and injure oranges. When the bugs congregate they form conspicuous red patches that may be jarred from the plants and destroyed. The bugs pierce cotton seeds, causing a brownish juice to stain the lint, ruining its market value.	Under sides of infected leaves may appear speckled with insects in different stages, but corresponding upper surface becomes white, brown or deadened in appearance. Winter may be spent under the scales of the bark of the host tree. Eggs may be glued to leaves with brown glue or imbedded in leaf tissue.	Man, domestic animals, poultry and other blooded animals are bitten by these insects. Some cause intense pain, faintness, vomiting and produce effects similar to bites of poisonous snakes the effects of which may last for some months in virulent cases. Related insects are more dangerous.	Suck juices of many plants, including gooseberry, currant, rose and many garden and ornamental plants including woody plants and herbs. New growth may wilt after bug has fed on it. Leaves show white or dark, 1/16- to 1/8-inch spots on upper side and leaves may wilt and fall if infestation is heavy.	Has been reported as a serious pest of cotton since the bite of the insect on a cotton boll may cause the boll to shrink and to decay. Evidence is small black spot, which becomes larger and sunken, giving a diseased appearance. Probably caused by juice introduced by insect.
Control is by destroying host plants, by clearing up rubbish and old plants in which adults may be wintering, by knocking colonies into buckets containing water and a film of kerosene or just hot water. Piles of cotton seeds may be used as traps to attract adults that may then be killed.	Injury to shade trees in times of drought may be severe and control should be begun in spring when young have hatched, and should be repeated at 2-week intervals, application being to under sides of leaves and being of contact insecticide type. May be DDT, nicotine sulfate, pyrethrum powder and like.	Chagas' disease of South and Central America is produced by a relative and may prove highly fatal. Some relatives feed most commonly at night. Some produce almost painless bites. Some feed on other insects. Screening to prevent access is about the only control method suggested.	Difficult to control because of activity but contact sprays are used, such as 40% nicotine sulfate 1/2 pint with 1 pound of soap in 25 gallons of water, or derris water, or pyrethrum applied in May or June, or dust with 4% nicotine and rotenone dust particularly before adults appear to lay new eggs.	Since so little seems to be known about the insect no special control seems to have been developed. Fortunately the insect is abundant as a pest only locally and at considerable intervals. In severe infestation the cotton bolls may be dropped entirely following attacks.

NAME SCIENTIFIC NAME	GIANT WATER BUG *Benacus griseus*	BEET LEAF HOPPER *Circulifer tenellus*	APPLE LEAF HOPPER *Empoasca mali*	MELON APHIS *Aphis gossypii*
DESCRIPTION	Length to 2½ inches. The largest of the giant water bugs. About ½ inch longer than *Lethocerus americanus*. Front legs fold into grooves in one section in *Lethocerus*, but not in *Benacus*. Front legs capable of holding prey and mouth parts capable of piercing flesh, making a painful wound.	Length about ⅜-inch. Pale green to yellow sometimes with dark patches. Wedge-shaped in superficial appearance. Legs long and slender and useful in making quick jumps. Adults fly readily when disturbed, appearing like minute whitish flies. Cause the disease curly top or blight, which is a serious injury.	Length about ⅛-inch. Pale yellowish-green with 6 to 8 distinguishing white marks towards the forward part of the back. In field may be spectacular when adults jump or fly quickly from badly infested spot. May appear in swarms under such circumstances.	Length about 1/25-inch. Known to some as black aphis or black fly. Wingless female may be yellow, green or black. Winged female has head and most of thorax black and abdomen yellow to dark green. Winged females can fly or be blown great distances. Usually recognized by injury to plant that has leaf edges curled downward.
RANGE AND RELATIONSHIP	Order Hemiptera. Family Belostomidae. May be found on ground under electric lights to which they are attracted. Live in water but migrate from pond to pond particularly during the breeding season. Usually migration of this sort is done at night. Related genera include *Lethocerus* and *Belostoma*.	Order Homoptera. Family Cicadellidae. As suggested in another column the family is one of the large families of the order with thousands of species to be found in America. This species is most abundant in western United States from Canada to Mexico east to Missouri, Illinois and Texas.	Order Homoptera. Family Cicadellidae. There are over 2200 species to be found in this family in the United States and Canada, where they are destructive to shade trees, forest trees, crops of many kinds, weeds and garden flowers. This species thrives on apple but may be on others.	Order Homoptera. Family Aphidae. This species is found throughout the United States south to Central America and South America. Most destructive abundance in the South and Southwest, where it may breed throughout the year. Found on many plants in open or in greenhouses over long season.
REPRODUCTION	Eggs laid in water on trash at edges of ponds in masses to 3 inches long, each mass containing to 100 eggs. Eggs in a single layer attached in more or less definite rows each egg to 1/5-inch long, oval and blunt-ended, brown, streaked. Incubation at least 10 days. Nymphs without developed wings.	Adults may winter on weeds. Egg-laying on beets begins by March and first generation may mature by early May, when adults may fly hundreds of miles establishing new colonies. Eggs hatch in about 2 weeks and generation may last 3 to 8 weeks, with 3 or more generations a year possible.	Winter spent in egg stage. Hatch in early spring and develop through 5 molts to adulthood, requiring about 1 month to reach maturity. With the winged adults the population may spread widely. Second or third brood may migrate from apple to potato. There may be 3 generations a season on potato.	Winged female produces living young at rate of 4 or 5 a day. These young in turn produce other living young when 6 days old. Female may move from leaf to leaf every 2 or 3 days founding new colonies. When food is scarce colonies may be small, but winged or wingless young may be produced at any time.
FOOD AND ECOLOGY	Food definitely living animals, which may be overcome and sometimes including fish to a few inches long. The bite, with its poison, undoubtedly aids in reducing struggles of victim that is attacked. Animals may serve as food for larger animals but definitely control numbers of smaller animals.	Insect may destroy or weaken critically sugar beet crop and may carry tomato yellows disease. Known to attack sugar beets, table beets, mangels, tomatoes, and to thrive on Russian thistle, which may be source of crop infestation. Most severe infestations seem to follow most severe winters.	Besides attacking apple and potato, this pest may cause serious injury to celery, sugar beets and beans, but its greatest injury may be to young apple nursery stock. Injury to all crops is greatest in times of drought when leaves and growing points of plants may wilt and die.	In Texas there may be 51 generations in 12 months, the average female producing 80 young if left to own activity. Males develop in fall in North helping produce fertile eggs, that winter over. Eggs may be found in North on live-forever. Plants attacked include melons, cotton, okra, beets, asparagus.
ECONOMIC IMPORTANCE	Not abundant enough to be of economic importance, but might be injurious in a fish hatchery where young are being raised, and where lights are often used to attract other smaller insects that have a definite food value. These insects should be handled with great care and respect.	Control is by destruction of winter hosts, particularly Russian thistle. Insect actually carries a filterable virus, which causes disease in plant. Wintering adults killed on hosts by spraying 1 to 1½ pounds of DDT to 3 gallons of kerosene per acre. Early planting and cultivation helps in control.	There are many close relatives living on trees such as birch, hazel, walnut, alder, oak, willow, poplar, dogwood, white pine, maples, etc. Best control is contact insecticide applied early in season before adults develop.	Other plants are citrus, spinach and a host of weeds. Control almost impossible by destroying hosts since they are so many. Instead contact sprays and soap emulsions applied in early season and repeated often may keep infestations down somewhat. Ants distribute aphids for honeydew.

GREENBUG *Toxoptera graminum*	WOOLLY APPLE APHID *Eriosoma lonigerum*	GREENHOUSE WHITE FLY *Trialeurodes vaporariorum*	COTTONY MAPLE SCALE *Pulvinaria vitis*	GRAPE PHYLLOXERA *Phylloxera vitifoliae*
Length of wingless female to 1/14-inch. Yellowish-green with a darker line down the middle. Eyes and most antennae black. Winged female has wingspread of to ¼ inch and has brownish-yellow head and the thorax lobes black or dark. Wingless and winged forms found through the year sometimes.	Appear as a white, cottony mass over a purplish plant louse, usually in clusters on bark and branches of trees. May appear like white powder in some stages, or may appear like a bluish-white cotton. Cotton or powdery substance is secreted by the aphid. Adults may be winged or wingless.	Length about 1/16-inch. Four-winged, snowy white, oval, flat. Nymphs smaller and pale green. Most easily recognized by nature of injury, leaves losing vigor, turning yellow, becoming sticky or glazed and supporting a sooty fungus growth. Both male and female may fly.	Appears like crowded, cottony pussy-willows, or cotton puffs, on twigs of woody plants, usually on the under sides of the twigs. Scales are females. Scale appears brownish, about 1/5-inch long with cottony material often coming from one side. Size varies considerably with the host plant. Winter scale may be under ⅛-inch.	Recognized by galls formed on leaves and roots of grape. There are 4 distinct forms of adults, as well as the immature stages. Injury recognized as a rotting of roots, or a yellowing of the foliage, followed often by the death of the host plant. Half-pea-sized galls open beneath, freeing wingless yellowish aphids.
Order Homoptera. Family Aphidae. A serious pest in European grain fields. First recorded in United States in 1882 in Virginia and now established practically through United States and southern Canada but not common in the Northeast. Worst in grain area west of Mississippi River.	Order Homoptera. Family Aphidae. This species is world-wide in distribution. In northern United States may winter as eggs or as immature nymphs, these hibernating underground on the roots of apple trees. Host trees include apple, pear, elm, mountain ash and hawthorn.	Order Homoptera. Family Aleyrodidae. Closely related to grape phylloxera and some aphids, but not in same family. Common infester of greenhouse plants in various parts of the country, and at almost any time of the year all stages of the insects may be found in greenhouses.	Order Homoptera. Family Coccidae. This species is widely distributed through United States and Canada, but is most destructive in the northern part of the United States. The family includes the bugs common on house plants, bark lice and many scale insects, some of economic importance.	Order Homoptera. Family Phylloxeridae. Native of eastern United States, but established in wine-producing France about 1863, with result that by 1884 1/3 of French vineyards were badly infected. Appeared in California about 1874 and is established in Russia, Algeria, New Zealand and South Africa.
Aphids that hatch from eggs are all females, which give birth to living young and during lifetime of 1 month produce to 100 young each of which produces living young at 7 days of age. Winged males and egg-laying females produced in fall, and the winter may be spent as eggs in North.	Eggs hatch in spring into wingless females that may be produced in 2 generations until early summer. The winged forms produced spread species to many trees of many species. In summer living young are produced. Fall wingless males mate with wingless females that produce a single egg.	Female deposits over 100 yellowish eggs on under side of leaf by short stalks, often in rings. Nymphs settle near hatching point and remain until adults for about 4 weeks, molting 4 times, spending 28 to 30 days in total time. Remain living as flying adults 30 to 40 days spreading infestations meanwhile.	Winters as small, brown scale on twigs and branches, all being female. With spring eggs are laid in cottony mass, a single female laying to 3000 eggs. Eggs hatch in early summer and nymphs crawl to under side of leaves, where they feed and mature in early fall, mate, and then males die and females hibernate.	Winter eggs hatch with developing leaves and produce a gall open at bottom of leaf. In gall, goes tnrough 3 molts in 15 days and these wingless females may produce 600 eggs in 3 weeks. Eggs hatch in 8 days and there may be to 7 generations a year, some moving to roots after 3rd generation. Winged forms come in fall.
Feeds on all small grains and wild and cultivated grasses. Found on corn, rice, and sorghum, for example. In South may winter as nymphs. There may be to 14 generations a year, and female may either lay eggs or produce living young, but males are produced only in last generation.	Particularly injurious to nursery stock. Some varieties of apples like Northern Spies seem to be resistant. Has as an important enemy a wasp-like parasite *Aphelinus mali*, which has been introduced into many countries to serve as a control and has been known to be effective if established.	Suck juices of many plants particularly cucumber, coleus, begonia, ageratum, hibiscus, geranium, fuchsia, lettuce, solanum and tomato. Nymphs are greenish and often crowded in great green patches seriously affecting leaves and whole of the host plant, sometimes ruining marketability.	This species attacks apple, beech, elm, grape, hackberry, honey locust, currant, gooseberry, Norway maple, poplar, plum, peach, sycamore, sumac, Virginia creeper, willow, and other trees, often killing parts of the hosts or all of them.	Fall winged forms breed and female lays single egg after mating. This egg remains in cane through the winter. Gall injury to leaves affects the quality of the grapes of the season. Forms dropping to ground and attacking roots cause roots to rot and die, thus affecting the crop badly.
Control is difficult but consists of destroying weed hosts particularly wild oats and volunteer oats. Usual contact insecticides and soap emulsions are used in control efforts with varying degrees of success. Burning infested plants, while practised, is hardly practicable.	Nursery stock should be rigidly inspected if moved. Root-infesting forms controlled by dipping nursery stock roots in strong nicotine solution and paradichlorobenzene applied to young tree roots to 6 years old has been effective. Insects on trunk controlled by wettable parathion.	Control by fumigation of greenhouse with hydrogen cyanide, or by aerosol treatment with tetraethylpyrophosphate or parathion. ⅛ to ¼ ounce of sodium cyanide usually sufficient to fumigate 1000 cubic feet of greenhouse, but there should be 3 to 4 weekly treatments. Rotenone used.	Control is largely by spring sprays before leaves start, using miscible oils at about 25% dilution, but such sprays must not be used after leaves have started as they may weaken trees and make them even more susceptible to scale attacks than would otherwise be the case.	Best known control is use of resistant stock ordinarily grafting European canes on native American resistant rootstocks. Sometimes root infestation is controlled by flooding the roots periodically, or by fumigation with carbon bisulfide. When replanting a vineyard, old stock is thoroughly destroyed.

(Continued from page 363)

cannot here review the many ways in which bugs move about. We can only suggest that you will find it interesting to investigate the subject yourself. Many bugs swim, fly, crawl, burrow, float, or are carried by other creatures, or otherwise get about. Possibly the most interesting of all these methods of travel is the way immature cicadas bore through closely packed earth by moistening it to make mud through which they can move easily.

How Bugs Reproduce. The success of any organism depends largely on its ability to reproduce. The meek shall inherit the earth if they have ample reproductive capacity. And while birds, and beasts, and almost any animal-eating creatures feed on bugs of one sort or another, directly or indirectly, there is some reason to believe that, long after most of the animals we now know on this earth have vanished, there will be somewhere a bug that still lives.

Read the story of how the aphids and scale insects reproduce, as shown in our charts, and you will get some idea of what happens with them. Think of an animal one female of which can lay 3000 eggs in a short time. Or think of one with which a female may produce 600 eggs in three weeks and has the ability to produce seven generations a year. Add to this the fact that many of these young animals do not need to find a mate to produce fertile young but merely start producing living young, which may, in turn, produce living young that may or may not eventually produce sexual forms that may mate and lay eggs. No matter what your imagination may suggest as a limitation to mass production, the bugs seem to have been able to side-track it. Eggs, sex, small numbers, limited food, drought, flood, heat or cold—the bugs can meet the situation successfully. Ornithologists may boast that a chickadee's stomach may hold 450 plant lice, but the 451st louse, if left to itself, may produce 80 young and be the progenitor in one year of 51 generations of plant lice. The year's production of plant lice would sound like the national debt.

One cannot consider that it is wholly negative that these insects reproduce so successfully. While they destroy plants and other animals there may be some value in limiting the prosperity of their competitors. This has to be considered to help to form a judgment in the matter.

Bugs in Relation to Other Animals. We have already suggested some of the relationships between bugs and other animals. They provide food for many animals. But some of these relationships are most intricate. Some aphids, for example, cannot, or do not, move readily and if left to their own devices might die in times of drought or excessive heat. These same plant lice may yield a liquid honeydew that is sought as food by ants. The ants protect their source of nourishment by moving the aphids from unsuitable pasture to greener fields. They may even take them under ground and let them feed on the roots of plants. The corn root aphid, which fits into this category, may do much to determine whether a farmer gets a new car or not.

We may have hinted that, by and large, bugs are undesirable citizens. We should not overlook the fact that many bugs prey upon other bugs and in so doing lighten the burden of keeping them under control. Surely, we have bedbugs, but we also have bugs that seek and kill bedbugs.

Taking it by and large, we find in the bugs a source of concern, of pleasure, of admiration, of disgust. We must live with them, and in some cases it would be difficult to live without them. They affect our health, our pocketbooks, our happiness, and are a challenge to our intelligence and ingenuity. When the grape phylloxera infested the grape-growing areas of France it affected the economy of a nation. When bedbugs get established in a house or hotel they affect the economic value of that place. Really, now, is it not worth while to put a little more time into the study of bugs than we can provide for you in these eight pages?

Many readers will wish to delve more deeply into the lives of the insects treated in this article. To that end we will supply a partial bibliography of useful and interesting books. Some of these are out of print and will, of necessity, have to be consulted in the public library. Some are recommended for use in identification, others for the pleasure of reading and the information contained in them.

Life and Love of the Insect by J. H. C. Fabre. 1929. The Macmillan Company.

Instinct and Intelligence by R. W. C. Hingston. 1929. The Macmillan Company.

Field Book of Insects by F. E. Lutz. G. P. Putnam's Sons.

The Insect Book by L. O. Howard. 1901. Doubleday, Doran. Important work but out of print.

Manual for the Study of Insects by J. H. Comstock, A. B. Comstock and G. W. Herrick. Comstock Publishing Company, Ithaca, New York.

The Insect Guide by Ralph B. Swain. 1948. Doubleday and Company.

Near Horizons by Edwin Way Teale. 1942. Dodd, Mead and Company.

The Junior Book of Insects by Edwin Way Teale. 1953. E. P. Dutton and Company.

Insects in Your Life by C. H. Curran. 1951. Sheridan House.

A Lot of Insects by Frank E. Lutz. 1941. G. P. Putnam's Sons.

Grassroot Jungles by Edwin Way Teale. Dodd, Mead and Company.

Insects of Western North America by E. O. Essig. 1926. The Macmillan Company.

The Gardener's Bug Book by Cynthia Wescott. 1946. Doubleday and Company.

Insects, Their Structure and Life by George H. Carpenter. E. P. Dutton and Company.

Marvels of Insect Life. Edited by Edward Step. Robert M. McBride Company.

Elementary Lessons on Insects by James G. Needham. 1928. Charles C. Thomas.