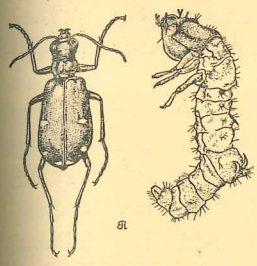
Beetles

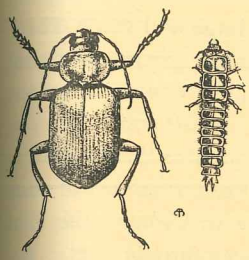
By E. LAURENCE PALMER

Illustrated by E. M. Reilly, Jr.

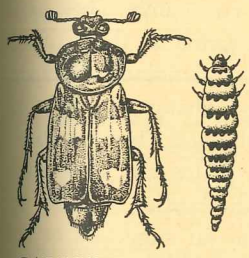
This is the fiftieth in NATURE MAGAZINE'S *series of educational inserts*



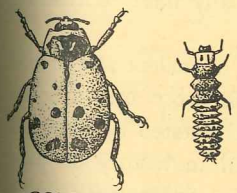
TIGER BEETLE



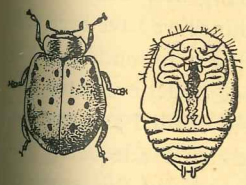
GROUND BEETLE



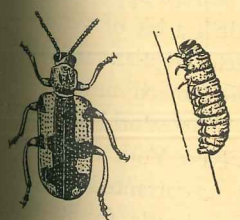
CARRION BEETLE



CONVERGENT LADYBIRD BEETLE



MEXICAN BEAN BEETLE



ASPARAGUS BEETLE

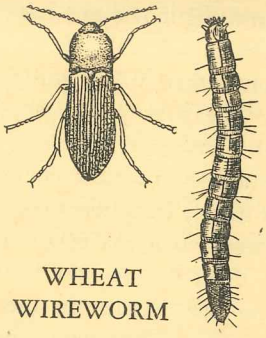
WITH this unit, we complete a half-hundred of these surveys of special features of Nature that seem to have special appeal. We have had to guess what your interests may be, and have tried to help those whose hobbies lie in studying stars, rocks, tracks, birds, insects, fishes, herbs, trees, reptiles, mammals and many other groups. We have gone to the sea, to marshes, to deserts and to weed patches for inspiration. We have appealed to those with academic interests and to those whose feelings are of a more home-loving type. It has been fun, and we only hope that the next half-hundred inserts may bring as much approval—and criticism—as we have had from the first fifty. We plan to spice the series in the future, as we have in the past, with numbers of a general nature. The inserts on sound, on age, on tracks, and on living out induced responses equal to those devoted to a consideration of more orthodox systematic divisions, and we feel such material should be represented by similar units in the future.

We welcome any suggestions from those of you who have stuck by this series through the years, and from those who are newcomers, as well. To help the old-timers whose series are complete, and to show the newer arrivals the scope of the series in the past, we are devoting the School Page in this number of NATURE MAGAZINE to an index to the subjects covered in these inserts. We hope that this will find sufficient use to warrant the effort put on its preparation.

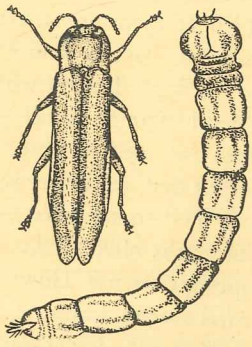
In part to get material for the new units in this series, we are starting on a trip that will take us from the Atlantic to the Gulf Coast, and on west to the Pacific, from Mexico to Canada and back through the northern United States and southern Canada. We have fifty pages in a notebook of a looseleaf type on which we hope to jot notes that will bring these new units of the series down to earth. We will talk matters over with you who are teaching, and with you who are not, and will try to act as a sort of Nature reporter. We like to think that this procedure will provide many new and stimulating contacts of a sort that will improve the usefulness of this feature of NATURE MAGAZINE.

And now it behooves us to get around to the subject of this particular insert. I chose beetles deliberately for this special insert because they have always had a particular appeal to me. Ever since I began collecting insects as a youngster I have favored beetles, for some reason or other. As a graduate student I developed a particular interest in whirligig beetles, and I am reserving a special place for these insects in the plans I am making for my old age. I never shall be an authority on the coleoptera or on any small section of that enormous group, but I am confident I shall never be bored if I keep trying to add to what I know of them.

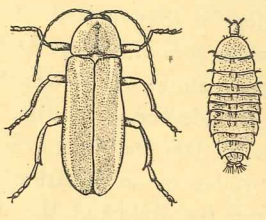
If any of you start studying these insects, you will certainly continue to be interested in them. I still remember the thrill I got when watching some whirligig beetle eggs hatch under a microscope thirty years ago this spring. And if none of you have ever watched the larva of a water scavenger beetle stalk its prey and overcome it when it has been captured, I am sure that if you can witness the event through a microscope, as I did, you will remember it longer than you will the most



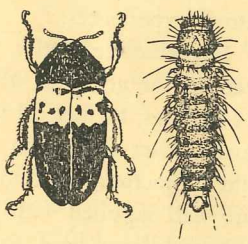
WHEAT WIREWORM



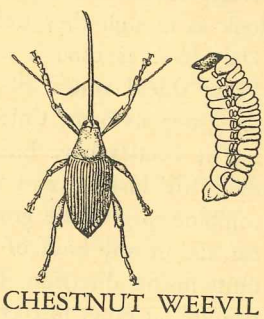
CHESTNUT BORER



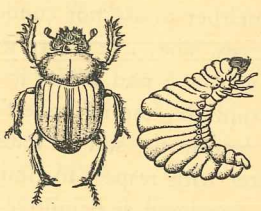
FIREFLY



LARDER BEETLE



CHESTNUT WEEVIL

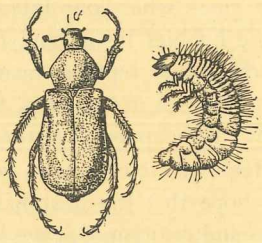


SCARAB

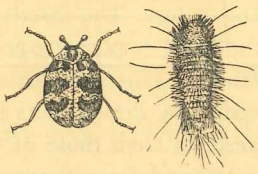
thrilling movie that comes to your town in this next month. Better than that, the beetle drama will cost you nothing, other than a little patience.

We gave you illustrations and life history material of the commoner aquatic beetles in the first unit of this series, and see no reason why we should repeat this material here. I merely want here to suggest one little inquiry about aquatic beetles that you may wish to investigate on your own.

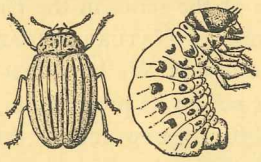
You all know the little whirligig beetles that run around in dizzy circles on the surface of streams and pools in summer. These whirligig beetles have four eyes. Two of them are directed downward and two upward, with a definite border between them at the water line. A world-famous entomologist friend of mine is perfectly sure that the lower eyes are used to observe possible food or enemies that are under water, and the other pair are used to see what goes on above water. To him, it is obvious that the structure implies an appropriate use. However, I happen to know a psychologist whose ability I respect, and who feels that the lower eyes do not function as they should. He has fooled with the living insects over a long period of time, using common-sense procedures to test what might seem to be the natural use to which these eyes would be put. He feels that they do not function. Possibly, you may wish to join in the study. A few beetles in an aquarium, with some device to test the ability of the insects to respond to a controlled stimulus, will give you some interesting experiences.



ROSE CHAFER



CARPET BEETLE



POTATO BEETLE

But what are beetles, anyway? We find members of the group to which they belong spoken of as bugs, as flies, as worms, as weevils, as grubs, and as many other things. In spite of this, the different animals have something in common. For one thing, most of them are well supplied with relatively hard forewings that cover the middle or back part of the body more or less effectively. Under a hand lens, these wing covers ordinarily look as though they were well supplied with rivet holes. They look as though they were well-constructed shields. These shield wings, of course, are the features that give the group its name Coleoptera, which means shield wings.

The beetles have biting mouth parts, a pupal stage in their life history, and a number of other characters that combine to give the group some semblance of unity. They eat almost any kind of organic material, so they have no unity in that direction. They may eat plants, animals, waste, manure, or other insects, and because of this variety we can neither praise nor condemn the group as being friends or foes. They live where it is hot, and where it is cold, where it is wet, and where it is dry. They are active in brightest sunlight, and in darkest midnight, high in the mountains or deep in the soil or water, so they have no common character with respect to time, place or temperature that can be considered as definitive. They have modified the prosperity of man favorably and unfavorably, have appealed to his most competitive instincts and to his laziest traditions. They have and will make and break communities economically, and they will not stay put. They have weaknesses that we have discovered which make our mastery of them partial at least, but they have other weaknesses that we know must exist, but which we have not as yet discovered. They can produce cold light, which we do not know how to duplicate. They are no doubt sensitive to sounds, odors and other disturbances that are meaningless to us. They can help physicians and can cause disease. They are beautiful and disgusting, active and sluggish, large and small. There are at least 250,000 known species, and they have lived on the earth, in one form or another, continuously from late Permian times to the Recent. They may complete their life cycle in a few weeks or may spend a number of years in the process. They can fly through the thinnest air, or make their way through metal, seasoned wood or firmly packed earth. They can swim and dive, burrow and climb. They have marital relationships as varied as those of all the races of human beings combined. They are sensitive to the slightest change, or able to withstand remarkable extremes. They have been pictured generically as villains and as saviors, and one or another of the beetles measures up to all of the extremes so far suggested or implied. In short, they are well worth knowing unless you are intellectually inert to challenging situations.

Beetles have appeared in ancient and in modern art, in the drama, in prose and in poetry. Their sounds have been imitated by musicians. Their names are written in history on paper pulp, on papyrus and on stone. Their remains are found in fossil muds and sands. In psychology, physics and chemistry, they have, we believe without intelligence, been able to match or exceed some of the undertakings we have been able to do with intelligence. They have been misunderstood as often as they have been understood, under-evaluated and over-evaluated, admired and despised, courted and avoided, welcomed and feared. Obviously, we cannot adequately present in eight pages a comprehensive story of this group of animals.

Texts galore have been written on animals in which the beetles are given just representation. Some have dealt primarily with the classification of the animals. Others, like those of Fabre, have presented their interpretation of beetle behavior. A. A. Milne gave us a juvenile's appreciation of a pet beetle in his "Alexander Beetle", a bit of verse that everyone should read at some time. Egyptian art makes much of the scarab beetle, to which much unwarranted significance was attached. The play "The World in Which We Live", which had a long run in New York a few years ago, drew delightful but probably unwarranted comparisons between the concern of a dung beetle for its little hoard and man's concern for whatever material wealth he can accumulate. Poe gave us "The Gold Bug", which was

really about a beetle, but he tied it beautifully into the treasure hunt idea we so frequently associate with Captain Kidd.

The poets vary in their mastery of the lore of the beetle. Some apparently know what they are talking about, while others obviously do not. Let me give you examples from Coleridge, Longfellow, Lowell, James Whitcomb Riley, Tennyson and Shakespeare to see if you can properly associate the poets' style with references they make to beetles of one sort or another. At the end of this article, you will find a key to the authorship of the verses quoted.

One of our poets writes: "The beetle booms adown the glooms and bumps along the dust". Another speaks of "crushing the beetle in his coat of mail". Few should fail to identify the authorship of this one: "The glow-worm shows the matin to be near". Still another, writing of midnight, uses the firefly as follows:

"The fireflies o'er the meadow
In pulses come and go."

This simple picture of firefly behavior is a bit more involved when we read from another poet:

"Many a night I saw the Pleiads
Rising through the mellow shade
Glitter like a swarm of fireflies
Tangled in a silver braid."

One of the poets mentioned has a more discerning understanding of firefly behavior than does a lesser light writing on the same subject. One of the poets quoted says:

"While many a glow-worm in the shade
Lights up her love torch."

The lesser poet, writing on the same subject, says:

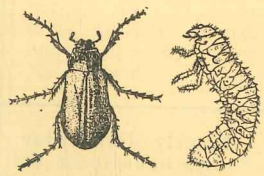
"Among the crooked lanes on every hedge
A glow-worm lights *his* gem; and through the dark
A moving radiance trembles."

Another lesser poet, however, recognizes the female as a common source of light, in writing:

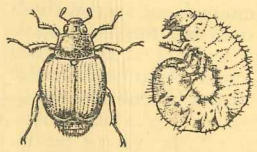
"When evening closes nature's eye,
The glow-worm lights *her* little spark
To captivate *her* favorite fly
And tempt the rover through the dark."

It is encouraging to find that the better-known the poet is, the more nearly correct may be his interpretation of our favorite subject. For the fun of it, we looked up what a beetle was in a well-known Bible concordance and found that it was listed as a sort of locust. I fear that we shall have to withhold comment on that one.

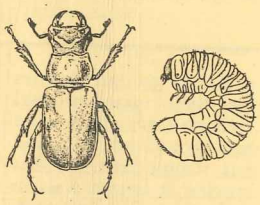
But now to more practical things about our beetles. Many of the details of the habits and control methods associated with the species here figured are given in the accompanying tables. These need not be repeated here. We could write of the invasions bettles have made into different parts of the country, and of the destruction they have caused when they have been freed from their natural enemies. We have the Japanese beetles as a recent and spectacular example of trouble that may be caused by some of the group. Here a species was moved suddenly a great distance. There are, however, slower migrations made by beetles that have been equally destructive. The Colorado potato beetle moved in from the west to the eastern potato field relatively recently. Still more recently, the Mexican bean beetle, a ladybird beetle, moved into territory where the school texts contended that ladybird beetles were useful destroyers of other insects. Some bean growers of whom I know in New York state have reservations regarding this popular generalization.



MAY BEETLE



JAPANESE BEETLE



STAG BEETLE

One of the more interesting uses to which man has put beetles, aside from using them to fight their own group, is that employed with some of the dermestid beetles. These beetles, in the larval stage, feed on meat—preferably meat that is somewhat spoiled. What is more natural, then, that where one wishes to remove meaty tissue the grubs of these beetles might prove useful. Zoologists charged with the task of cleaning skeletons for demonstration purposes found it much simpler to let the beetle larvae do their work for them than to wield their own scalpels. Besides, the beetles could be so controlled that just the proper amount of cartilage could be left to hold certain bones in position. It was only natural that if beetle larvae could be used to remove flesh that was dead, while they avoided living tissue, that this property might be used in cleaning away dead tissue on living animals. The animals have had a limited use in this direction.

A European blister beetle, *Lytta vesicatoria,* is commonly known as Spanish fly. This beetle is ground up into a powder which, when applied to the skin, may cause serious blisters. In a restricted form, it has sometimes been used as a medicine. Of course, the fireflies also are beetles, whose common name carries the term "fly."

The term "bug" is also applied to a number of common beetles. For example, we have ladybugs that are beetles; Junebugs that are beetles; tumblebugs that are beetles. Unlike the true bugs, these beetles, of course, have chewing mouthparts rather than sucking mouthparts.

While flies and bugs are words used rather promiscuously to refer to insects in many orders, it is not common to find such terms as weevils and chafers and the like applied to anything but the coleopterous insects.

Social life, as we find it represented in some other orders, is not common among beetles. We have tent caterpillars building community homes, among the lepidoptera, and, of course, the wasps, hornets, bees and ants living in complex social groups. But in the beetles there is little of this. True, many beetles may be crowded together at a given point at times, but this is merely because suitable food is there, and the population has not been depleted by enemies. Possibly one might recognize some community spirit in what happens with the engraver beetles, but this is not in keeping with our ideals at all times, and it may be merely a matter of convenience rather than any social scheme.

(Continued on Page 312)

COMMON NAME SCIENTIFIC NAME	TIGER BEETLE *Cicindela sexguttata*	GROUND BEETLE SEARCHER *Calosoma frigidum*	CARRION BEETLE *Necrophorus marginatus*	CONVERGENT LADYBIRD *Hippodamia convergens*
DESCRIPTION	Length: 7/16- to ½-inch. Usually, a brilliant metallic green or blue green with rather conspicuous but small, to 10, ivory markings around the margins of the wing covers. Legs: long and slender and capable of rapid movement. Antennae: relatively slender and about the length of the front legs.	Ground Beetles are usually black or dark colored. Some are bright colored, or with bright parts. They are up to one inch long and are active in the larval and adult stages.	This species is nearly an inch long, with a cylindrical body. It is dark with dull, red markings on the fore wings. These wings frequently do not reach the end of abdomen. Animal appears stout and rugged.	Length: about ¼-inch. With 2 white, converging dashes on back, in front of wings, and 13 black dots on the orange wing-covers, and a white border on the thorax. General appearance like a small "split pea." Some lady beetles are red, black or yellow spotted, and some entirely black. Larvae: active, usually dark-colored.
RELATIONSHIP AND GENERAL	Family Cicindelidae. The tiger beetles. More than a hundred species are known, in one form or another, over the United States. They are practically all beautiful, active species, useful rather than destructive, and interesting because of the habits of both the adults and the larvae.	Family Carabidae. Found usually on the ground, commonly under trash, where it may be moist. Some species climb trees but this is unusual. There are at least 1200 kinds of ground beetles in the United States.	Family Silphidae. Found usually on dead animal matter usually under cover. There are more than a hundred species of carrion beetles known in the United States, including *Silpha americana,* a common short, flat, round insect.	Family Coccinellidae. Adults common, and larvae very common on melon vines. Some adult beetles are found in houses on windows in spring and fall and some congregate in great numbers under trash on the ground. About 100 species of lady beetles in North America. Mostly useful, but some pests.
REPRODUCTION	Adults are usually active through the warmer months, most species in bright sun, but some at night. Males show 7 abdominal segments; females, 6. Larvae of tiger beetles usually live in vertical burrows in sand or hard earth with jaws ready at bottom of pit to grab insects that may fall into the pit.	Some ground beetles lay their eggs in mud cells on leaves. Larva can run around actively, and has strong jaws. In this species, it lies in wait in a burrow for its prey. Larva may molt twice in about 2 weeks, then turn into an inactive larva for another 2 weeks, then become a pupa for a week, before becoming adult.	A pair of *Necrophorus* finding a dead bird or piece of carrion will remove the earth from beneath and place it on top, eventually burying the flesh. On the buried flesh, the female lays her eggs, which hatch into larvae that feed on the flesh thus provided. The pupal stage is passed nearby.	Eggs laid in spring, on plants after adults have hibernated in great numbers, usually in highlands. The larvae begin eating small insects and insect eggs or even spiders, and grow rather rapidly. They finally transform into pupae that hang by the tail a few days before transforming to the adult stage.
FOOD AND BEHAVIOR	Behavior of adults in alighting on sidewalks to face you as you approach, of the larvae that will grab a blade of grass thrust into their burrows, makes these insects worthy of continued study by the average field naturalist, not only because of the vigor of their actions, but for other reasons.	Food of almost all ground beetle larvae and adults is other insects, particularly soft-bodied caterpillars, which are run down and eaten. They are most active at night. Adults may live nearly a year, wintering in that stage, with the egg-laying limited to early summer, in some species.	Food of larvae and adults, of course, is the carrion they find and bury. Some carrion beetles may attack and kill small animals like snails, and some live on decaying vegetable matter. Some of the larger insects may move an animal the size of a rat some distance to get it buried properly.	Food of this species, small animals only, including many kinds of plant lice, asparagus beetle eggs, eggs of Colorado potato beetle, grape-root worm, bean thrips, alfalfa weevil and chinch bug. The related Mexican bean beetle is a serious plant crop pest of the Southwest, and has spread to New England.
ECONOMIC IMPORTANCE	Probably more useful than harmful, since they are essentially destroyers of other insects. No doubt they do not discriminate between those that are useful to man and those that are not. Because of this it is not probable that any control measures may be necessary or desirable.	Ground beetles are useful throughout their lives, since they prey on other insects that are for the most part harmful to man's interests.	These insects serve primarily as scavengers, and, for the most part, may be considered as beneficial. Those species that are close relatives, such as *Silpha bituberosa,* which feed on vegetable crops, of course may be considered as pests. These are mostly western.	On Pacific Coast, convergent lady beetles were collected in great numbers and distributed in crop areas. 30,000 are considered adequate for protecting 10 acres of cantaloupes from scale insects. They were collected by the ton. Mexican bean beetle controlled by spray of 1 pound of magnesium arsenate to 50 gallons of water, or by dusting.

MEXICAN BEAN BEETLE *Epilachna varivestis*	WHEAT WIREWORM CLICK BEETLE *Agriotes mancus*	TWO-LINED CHESTNUT BORER *Agrilus bilineatus*	FIREFLY *Photuris pennsylvanicus*	LARDER BEETLE *Dermestes lardarius*
Length, about 1/3-inch. Width, about 1/5-inch. Light yellow to yellow brown with 8 conspicuous but small black spots on each wing cover, but with no black spots whatever before the wings. Legs, relatively long and slender. About equally rounded in front and rear. Head, inconspicuous.	Length, 1/3-inch. Dull, red-brown, darker in the forward parts. More or less uniform in diameter and bluntly pointed at each end. Apparently conspicuously jointed 1/3 distance from the front. Antennae, slender, divergent. Legs, about equal in length, relatively slender, and are folded when animal is disturbed.	Length, 3/8-inch. Slender, with relatively parallel sides and with body generally uniform in diameter in forward 4/5 of length. Antennae, short, backward curving. Eyes, to the front. Legs, about equal in length and but little modified. Black, with a slightly greenish tinge, somewhat sparingly clothed with a golden-yellow fuzz.	In *Photuris*, the head is not completely covered from above as is the case in the related *Photinus*. In *Pyractomena*, and in *Photinus*, eyes are large in males and light organs well developed in females. Legs, comparatively short. General shape, oblong and flattened. Antennae, rather long and nervous. Some species do not give off any light.	Length, 1/4- to 1/3-inch. Dark brown, with a pale yellow band across the forward half of the wing covers covering nearly 1/3 of the total length and bearing irregularly placed dark dots and narrow bands, but usually with 3 dots on either side of the central line. Antennae, short and relatively slender.
Family Coccinellidae. Related to the ladybird beetles most of which are useful. Range originally in the southwestern states of New Mexico, Arizona and Colorado, to which it had migrated from Mexico, is now extended to New England. A recent report from Kansas says it is not now known from that State.	Family Elateridae. Relatives include click beetles or wireworms, which are serious pests of corn, sugar beets, cotton and many other plants, including some woody plants. Some relatives prey on other insects, at least in the larval stages. Many of the larger ones are found most commonly under dead wood of fallen trees.	Family Buprestidae. Members commonly spoken of as "squareheads", but rather closely resembling the ordinary click beetles. Relatives attack apple, raspberry, blackberry, pine, maple, poplar, beech, birch, sumac, and dogwood and other woody plants, in which they bore as larvae. Some attack herbaceous plants, living as leaf miners.	Family Lampyridae. The fireflies. Best known as lightning bugs, and the larvae or wingless females as glow-worms. There are over 50 species of fireflies in the United States and many more to the south. Most of them are nocturnal but many common forms are to be seen by day feeding in fields and gardens.	Family Dermestidae. Relatives include the buffalo bug and a number of museum pests, as well as some species that are used in laboratories for cleaning skeletons, and to some extent in medicine. Rather widespread in homes where conditions are suitable, but do less well where rugs are movable or where materials are changed often.
Adults appear in spring at about time beans appear above the ground, lay eggs (yellow) under the leaves. In a few days, spiny grubs hatch and begin feeding on the leaves. When mature, the larvae pupate on the under side of a leaf, and from these pupae the adults emerge in a few days. Winter spent in adult stage. One annual brood.	After mating in April or May, female lays eggs under ground. Larvae become half grown by season's end and complete growth the second season. When mature, they enter an earthen cell and pupate during third season, emerging as adult about three years after egg stage.	Eggs, laid in spring on the proper host tree. Grubs enter growing tissues of the outer bark and on through inner bark to sapwood, forming flattened cross passages that may occur from top to bottom of the tree. Larval stage may last through to next spring, becoming pupae in bark or outer sapwood for about 2 weeks before emergence of the adult.	Sexes probably attracted by light emitted by female. Eggs of some species are luminous. Larvae of some species may glow in the soil, where they live, or under bark or plant trash, where they seek soft-bodied animals such as earthworms or snails, on which they feed. Pupal stage is usually passed under ground for about 10 days.	Adults enter houses in May. Lay eggs on food or in cracks and crevices in pantry or near meats, particularly those that have begun to spoil. Larvae develop rapidly and it is probable that a generation may be completed in from 45 to 50 days, permitting several generations to develop in a year. Adults may leave house or remain in it.
Mature and developing larvae do tremendous damage to leaves and fruits of beans. Larvae are about size of the adult, but are light yellow and covered with black-tipped, stout, branched spines when mature. Some control is effected by cleaning up old trash and plowing infected fields, or hand-picking may be worthwhile at times.	Most destructive stage is the larval period when the insects destroy many roots of important plants. Adults may be attracted to light and are identified by reddish color. Larvae have 2 dark spots at base of last body segments and may reach a length of at least 1 inch.	Adults have habit of sunning themselves on the host tree during May and June, when they are flying, mating, and laying eggs. At this time, they may be collected by holding a cloth beneath them and striking the tree violently. Grubs are 1/2-inch long, cream white with pair of brown forks at the rear. They do the damage.	Food of different species varies, from animals already suggested to plant material. Light is cold, produced in the abdomen, probably by oxidation of granules in outer layer, oxygen being supplied by tracheae under control of nervous system. Some species flash lights in unison. Light is usually yellow.	Cheese is most attractive to these beetles and may be used as bait to attract large numbers where they may be killed in quantity. Cheese ground with arsenic may be used as a poison bait, but it is of course dangerous to leave where it may by accident get into the food of pets. Infected parts of meats should be cut off and destroyed.
Normal control is by dusting plants with paris green diluted with 100 parts of air-slaked lime, often applied with Bordeaux mixture used for fungus control using 1 pound of paris green to 200 gallons of Bordeaux. This species makes fools of the science education testers who repeatedly contend that ladybird beetles are all useful.	This species is destructive of potatoes, corn, wheat, carrots, turnips, cucumbers, beans, as well as of pasture and lawn grasses. Control is by practicing short rotation of crops, which interferes with the essential 3-year life cycle. Larvae and adults may be attracted by baits of clover dipped in paris green.	When chestnut was abundant this insect was a serious pest and it is still dangerous in areas where the tree survives. Damage appears first when the tree begins to die from the top. In Europe, trees are killed to serve as traps that once infested may be destroyed entirely.	Of little economic importance except as suggested above, but of tremendous challenge to understand the production of a cold light. Of course, they have inspired poets and story tellers. A Jamaican marsh lighted at 10-second intervals by host of fireflies simultaneously is a sight not to be forgotten.	Larvae are easily recognized as hairy-bodied animals that cluster on infected areas. Where pest is abundant, it may pay to fumigate storeroom or pantry with carbon bisulphide or cracks may be sprayed with benzine under careful supervision to avoid fire. Infected meat not destroyed may be treated with dilute carbolic acid.

COMMON NAME SCIENTIFIC NAME	BUFFALO BUG *Anthrenus scrophulariae*	STAG BEETLE *Pseudoleucanus* sp.	SCARAB BEETLE TUMBLE BUG DUNG BEETLE *Scarabaeus* sp.	JUNE BUG MAY BEETLE *Phyllophaga* Spp.
DESCRIPTION	Length, about 1/7-inch. Attractive, black, white and red, with a black background, spotted and speckled with white, and a central red line down the back. Larvae, nearly ¼-inch long, clothed with long, brown hairs, those on the sides and under rear parts being the longest.	Stag beetles may measure about one inch in length. The males especially may be characterized by having large jaws. Color, usually black or red-brown, usually appearing smooth but really finely pitted. Head and eyes are usually prominent. Antennae, of 11 segments and elbowed, with 3 end segments grouped to form a club.	Illustrated is the sacred scarab, *Scarabaeus sacer.* When at rest, the legs may be folded tightly, and the conspicuous back and uniquely scalloped legs are black or nearly so. Beetles are relatively active and males and females resemble each other closely. Have long attracted the attention of people.	Length, to one inch, or as short as ½-inch. Stout, dark brown, and usually glossy above, with small heads, relatively slender legs, and a stupid behavior. Larvae, "white grubs", usually with rear bent forward beneath, dark heads, and short, stout legs forward.
RELATIONSHIP AND GENERAL	Family Dermestidae. Introduced into America about 1869, and many times since, it has become a serious pest. It is a native of the Old World, where it was worst in museums, but it is now established in America from coast to coast. Strange to say, it seems to be worse where established in America than in Europe.	Family Lucanidae. Relatively few species, including those that are commonly spoken of as "pinching bugs". Jaws of the males are frequently twice the size of those of the females. Some species have branched jaws that resemble antlers of a stag and give the group its name.	This species, *S. sacer,* is native of the Mediterranean countries and has been well known in Egypt for centuries. The family is Scarabaeidae with at least 20,000 species, among which are the well-known May-beetles. Most of the genus *Scarabaeus* are found closely associated with dung of cows or horses.	Family Scarabaeidae. Adults found in tree tops, or in houses where they are attracted by lights at night. During day, remain hidden. Larvae, underground. At least 100 species of the genus. In South, they are common in longleaf pine area. Less common on West Coast, but worst in Mississippi-Great Lakes region.
REPRODUCTION	Wrinkled, white eggs are laid on clothing, feathers, furs, silks, carpets. These hatch in 2 to 3 weeks into grubs that reach 1/5-inch, during which time the skin is shed 6 times and destruction takes place. Pupae are formed within the last larval case and are smaller than the larvae. Adults appear in fall and winter.	Adults commonly fly by night, producing a startling buzzing sound and may be frightening in habits. Larvae commonly are found in dead, decaying wood, particularly if it is damp, and develop from eggs that are commonly laid in bark crevices at the base of tree near where decay is taking place.	Adults make little balls of dung in which the egg is placed and which is rolled to a secluded spot and hidden. Usually, a single egg is laid in a dung ball and the resultant larva develops within the ball, feeding on it. Pupal stage is spent in the cavity in which the dung ball was hidden.	Eggs, 50 to 100, white, cylindical, laid in glued-earth cell underground, hatch in 10 days to few weeks, into white grubs, which do not mature until the 2nd or 3rd summer, spending the winters deeper in the soil. Pupal stage, in earth cell, 3 to 10 inches underground, about 3 weeks in August or September.
FOOD AND BEHAVIOR	Food, of adults, pollen of flowers, such as *Spiraea;* but of the larvae, it is usually materials valuable to man. Adults found in spring and winter on ceilings and windows attempting to escape to out-of-doors. Both adults and larvae tend to congregate at different places.	Adults of some stag beetles are attracted by light and this, accompanied by the buzzing produced in flight, often brings startling results to summer campers inexperienced in their ways. The adults may feed on decaying wood or on plant juices, some favoring particular species of plants.	Fabre and others have written extensively on the habits of these beetles. Some attribute the ball rolling to one sex, some to the other, and some consider that both participate in its making and care. Some species do not make dung balls, but lay the egg in a nearby dung-packed hole.	Food, plant material, through 3 years of life cycles. Adults feed at night on tree foliage, returning to hide in soil at daybreak. Adults feeding may sometimes be heard. Different species have plant preferences at different ages. Grubs have important bacterial enemies, and are eaten by some animals.
ECONOMIC IMPORTANCE	Control is by keeping adults from laying eggs on valuable property, by using wool baits from which adults may be destroyed, by use of sulphur fumigation, and kerosene in cracks where larvae or adults may hide, and by destroying infected materials where this is possible.	Stag beetles are rarely abundant in sufficient numbers to be considered as serious pests, and since the food of the larvae is largely of already decaying wood, they may be considered as useful in reducing unproductive tissue, thus making room for new growing material.	Egyptians considered the sacred scarab symbolic of the Resurrection, in which life came from death. They also considered the ball representative of the earth and the beetle of the sun with its rays represented by the peculiar leg flanges. Roman soldiers wore sacred scarabs set in rings, because of faith in their power as charms.	May strip trees of their leaves, grass sod of its roots, and may completely destroy such crops as potatoes, small grains, buckwheat. Control, by crop rotation, by deep fall plowing, by pasturing pigs, chickens in infested fields, by use of decoy lights to attract adults to traps, and by protecting crows, blackbirds, and skunks.

ROSE CHAFER *Macrodactylus subspinosus*	JAPANESE BEETLE *Popillia japonica*	ASPARAGUS BEETLE *Crioceris asparagi*	COLORADO POTATO BEETLE *Leptinotarsa decemlineata*	CHESTNUT WEEVIL CURCULIO *Balaninus rectus*
Length, 3/8-inch. Slender but tapering at each end. Body, brown, thickly covered with a fine, yellow fuzz giving the animal a yellowish color sometimes. General color, gray brown. Legs, long, slender, pale red. Actions, awkward and ungainly. Antennae, relatively short and knob-ended. A definite constriction in front of wings.	Length, about 1/2-inch. Shining green body, with white spots on the end of the abdomen behind the end of the wings. Popularly described as a green potato beetle. Larva, like small white grub, and sometimes known as the green Japanese beetle.	Length, about 1/4-inch. General color, bluish-black, often tinged with green. Inner margin of wing-covers, blue-black, but tip orange with yellowish-white and blue-black design between. Thorax, usually red, with 2 black spots near the center. Antennae, moderately stout. Red on the legs.	Length, adult, under 1/2-inch, and about 2/3 as wide as long, with high, arched back. Clay yellow, with 10 conspicuous, black lines on the wing-covers. Head, with a black spot above. Larva, dull, brick-red, soft, fat, and with a row of dark spots down each side.	There are a number of similar and closely related nut weevils of which this species is representative. Adults are usually from 1/4- to 1/3-inch long, generally yellow with darker markings and with long, slender snout that bears cutting jaws at the tip. Snout is approximately 1/2 the total length of the insect.
Family Scarabaeidae. Relatives include the dung beetles, June beetles, Japanese beetles and rhinoceros beetles. This species widely distributed from Maine to Georgia and west to New Mexico and Colorado but most abundant in the northeast in this area. Listed in Kansas as not common but present.	Family Scarabaeidae. A native of Japan that was discovered in New Jersey in 1916 and has since spread over a wide territory. In the first 8 years in America, it appeared in an area of over 2500 square miles and still was not under control. Often so abundant that 1500 grubs may be found in one square yard of sod.	Family Chrysomelidae. About 1000 species in the family in America. This species ranges from Massachusetts to North Carolina and westward through Canada and Illinois having been introduced on Long Island about 1860, and in California about 1904. It is also known in the Rocky Mountain States.	Family Chrysomelidae. Found mostly on potato plant, but originated on the buffalo-bur, *Solanum rostratum*, native of the Rocky Mountain area. Began to spread from that area in 1859, moving at first at about 50 miles a year and reaching the Atlantic Coast about 1874. Adults may be found hibernating in the ground.	Family Curculionidae. In the family are many important snout beetles, weevils, leaf rollers and the apple curculio as well as the billbugs and grain weevils. Most have rather specific food preferences that limit range, but many are more cosmopolitan in food and territory. Cotton boll weevil is possibly the most famous.
Beetles leave ground as grapes bloom, feeding on flowers of many important plants and detroying fruit. Eggs laid in soil to depth of 6 inches, in pockets containing about 12 eggs. Eggs hatch in 2 to 3 weeks into 1/8-inch, whitish grubs, with yellowish heads and dark brown jaws, grubs mature by November. Pupate for 3 to 4 weeks.	Tiny, white eggs are laid usually in uncultivated soil, in July or thereabouts. The white grubs that hatch from these feed through the summer, spend the winter deeper underground, enter the pupal stage for a short time in the spring, emerge as adults in June and July, mate and feed for 2 months or more, causing great damage.	Adults come from winter hiding in brush or under bark, and attack tender asparagus shoots, laying 2 to 8 1/16-inch eggs in clusters. Eggs hatch in 3 to 8 days. Gray-headed, black-legged grubs mature in 10 to 14 days at 3/10-inch length, fall to ground and pupate under ground for from 1 to 2 weeks. Egg to egg in 3 weeks.	As soon as potato plants appear above the ground, fertile female potato beetles lay their masses of yellow. 1/14-inch eggs, usually beneath the leaves. These hatch in about one week into red larvae that grow for 2 to 3 weeks before pupating underground near the potato plants. After about 2 weeks, adults emerge and the 2nd generation starts.	Adults usually leave ground in early spring but continue coming out for some time. When nuts have developed sufficiently the husk or bur is penetrated and punctured with long snout, and eggs are laid inside the fruit. Larvae develop in fruits until they fall, then eat their way out, and winter in the soil where they pupate.
Adults may be killed by baiting with molasses poisoned with lead arsenate. Vines are sprayed with 8 pounds of lead arsenate to 2 gallons of molasses to 100 gallons of water. Larvae may be controlled somewhat by cultivation and crop rotation but even then with difficulty because of range of diet.	Food, of larvae and adults, many kinds of cultivated plants, favoring grapes, raspberries, blackberries, strawberries, apples, cherries, corn, clover, soybean, rose, hollyhock, elm, birch, linden and many other valuable kinds of plants. When feeding in great numbers, they may leave nothing green growing.	In North, there may be 2 generations a year; in the South, 4 to 5. An hymenopterous chalcid fly is parasitic on the asparagus beetle eggs and larvae, and serves as an excellent check, each infected larva being capable of producing to 10 parasites. Poultry destroy many adults when present.	Food, of larvae and adults, plant tissues only, and preferably potatoes and associated plants. Tomato and eggplant may sometimes be attacked as vigorously as are potatoes, and there is no growing season of the plants when the beetles may not be in active destructive condition.	Larvae do serious damage to fruits of plants of use to us as food and for fiber. In the case of the cotton-boll weevil the insect forced a new pattern of agriculture on an extensive area in the South by making the single crop technique too dangerous to follow. The injury may be real as well as merely affecting market values.
One of our more destructive insects but worst on light sandy soil, which the female favors as an egg-laying site. There is usually one generation a year. Insects are characterized by a persistent mating habit in which male may cling to female even when she goes underground to lay her eggs.	Control by burning trash, and by use of a strong spray, at least 3 pounds of arsenate of lead and 2 pounds of flour to 50 gallons of water, though peaches will not survive this spray. Some parasites have been introduced that will probably provide the best pathway of attack, and may eventually provide adequate control.	Adults may be poisoned by lead arsenate paste. Infected plants should be burned. Clean cutting of shoots early in season may interfere with early broods and limit crop of the year. Plants may be dusted with land plaster. Hens, 30 to 40 per acre, should care for a normal infestation.	Natural enemies include crows, skunks, rose-breasted grosbeaks, toads and numerous insect enemies. Usual artificial control is by dusting with Paris green, usually mixed with 10 to 20 parts of some inert material, or used as a spray, or lead arsenate is used as a spray.	Nut weevils may be controlled somewhat by fumigation of clean harvested crops, with carbon bisulphide. Interesting to entomologists because of the appropriateness of their structure to the nature of the plant in which the eggs must be laid or the food procured, representative of some of the niceties of Nature.

In some of the engraver beetles, we find a male building a sort of private love nest or retreat under the bark of some suitable tree. When conditions are to his liking, a female enters and eventually lays her eggs in the walls of their common retreat. In some cases, the female may leave, only to have her place taken by another, which eventually leaves her contribution to the next generation in the walls of the nest prepared by the gay blade. As the young of mixed parentage hatch from the eggs, they begin to eat their way between the bark and growing wood tissue, making tunnels larger and larger as their girth increases. Eventually, they form pupae at the ends of the divergent trails, break their way to freedom through the bark and no doubt live lives comparable to those of their parents.

You no doubt have seen these burrows of the engravers when you went to make a fire in the woods. You picked up a piece of wood that may have looked as though it had been pierced with shotgun pellets. When the bark peeled off, you saw beneath it what may have looked like a long-bodied spider with many divergent legs that were smallest where they left the parent cavity. You know now the story of how this spider-like engraving was developed.

Varied and ingenious as the life histories of beetles may be, man has repeatedly discovered ways in which they may be broken down and the creatures brought under control thereby. Most of us as youngsters have had the experience of being assigned the boresome job of picking potato beetles off the potato vines. This is a rather direct means of attack, but it is rarely thorough and hardly practical on a large scale.

Of course, you all know of the practice of using poison to destroy some kinds of beetles. Usually, this is a stomach poison that is taken in with plant tissue that the insects chew. Such poisons have little effect on the true bugs, which merely pierce the poison film and feed nonchalantly from the hidden plant tissue. Some beetles seem to have a sense of taste and have been known to avoid some of the poisons set to accomplish their doom. Man steps in in such a situation and diabolically adds a little molasses to the poison so that the beetle will eat what is not good for him.

Not a few of the beetles are attracted by light, as you may well know. You have no doubt heard June beetles crash against the screens covering a lighted window in early summer. Also, you have examined the bowls under ceiling lights in your home and found therein dead beetles whose penchant for the great white way was too much for their own good. Again, you have seen the click beetles on the ground under a street light or a porch light. They spin around on their backs and suddenly spring into the air only to alight on the right side. These click beetles and these June bugs are in themselves not serious pests, but their larvae do tremendous damage burrowing under ground, sometimes for as much as three or more years.

Since many beetles have rather specific depths in the soil at which they spend critical times in the year, man often helps destroy them by plowing or cultivating, so that the beetles or grubs are exposed to freezing, or to the attacks of crows. This system calls for an understanding of the life cycle of the trouble maker, and an integration of effort with that knowledge so that the life cycle is broken.

Sometimes it is just as simple to control some beetles by changing the crops grown on a piece of ground so that suitable food is not available for a period long enough for the animal to complete its life story. Crop rotation is often planned to help in a situation such as this, just as it is planned to meet the needs of soil management.

Almost the reverse of crop rotation is represented by the practice sometimes of providing what seem to be suitable resting quarters for beetles that have regular movements from place to place at regular times. If a beetle has the practice of seeking cover under a board in the heat of the day, or the chill of the night, a board properly placed may serve as a gathering place for such insects. Once they have established themselves in apparent security, they may be destroyed by removing the board at the proper time and taking care of them in any way that seems convenient.

In recent years, economic entomologists have carried on their warfare against some of the beetles that burrow under ground by using another method. We might call this honestly biological warfare. Possibly, men may come to use somewhat similar techniques if we have another war, although we hope that this is not to be. In the warfare against the beetles to which I refer, we know that some of our white grubs show dark areas to the rear. Some of us who have used them for bass bait have noticed that some of them give off a white milky juice when they are pierced by the hook. Such insects may well be infected with a bacterial disease that will kill.

Men who know this have discovered that the bacteria may be so placed that they will infect an abnormal number of the grubs. In some cases, it is the practice to mix the bacteria with some substance that will spread it widely. Some kinds of dust are most suitable for this purpose. Then, the infected field is sprayed with the bacteria-infected dust and the healthy grubs come in contact with their little enemy.

Probably the most subtle and intelligent practice for controlling beetles is by encouraging their natural enemies to be present. Skunks were first protected by law in New York State because of the service they rendered in destroying a borer that interfered with the hop crop. Crows have been found stuffed to their throats with the grubs of beetles that would have killed the corn if the crows had not killed the grubs. And, in addition to this, those who know their insects are able to encourage the little parasitic wasps and flies that normally live on the larger beetles or their larvae.

And so we come to a point where we must leave you to your own devices for further studies of the beetles. We should have given you more than enough leads by now.

NOTE: To help you identify the poets mentioned earlier we give you this little directory. James Whitcomb Riley wrote about how the beetle "booms"; Longfellow about its "mail". Shakespeare, of course, used the beetle to show "the matin to be near", and Lowell watched their lights pulsating in the meadow. Tennyson associated the fireflies with the Pleiades, and Coleridge got the sex right when he had the firefly light "her love torch".