4-H CLUB INSECT MANUAL

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NOTE.—Grateful acknowledgment is made to the Division of Insect Identification of the Bureau of Entomology and Plant Quarantine for selecting the list of representative insects of the United States, for providing photographs or drawings of them, and for the outline of the story about each insect. The other subject-matter divisions of the Bureau reviewed all references to the biology and control of the insects listed. Acknowledgment is also made to the extension entomologists and 4-H club workers in the States who offered suggestions that have aided in making this manual useful and workable.

4–H CLUB INSECT MANUAL[1]

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INTRODUCTION

This insect manual was prepared primarily for the use of 4–H club members, but it also may be useful to other groups of young people. Its purpose is to give a better understanding of insects and the principles underlying insect control.

The study of insects at camps affords an ideal way to introduce entomology. Under a competent leader who knows insects many interesting things can be pointed out, such as facts pertaining to insects in relation to other forms of life. Although this manual was prepared primarily for a definite year-round project in entomology, it will be helpful at camps also.

Valuable service can be rendered through learning to recognize threatening insect populations and making counts to determine how abundant they are. Club members can be of help to entomologists and to their neighbors if they will be on the lookout for insect pests and report to their county agent, or to the State or Federal entomologist the finding of unusual varieties and the outbreak of these and of common pests. If these reports are of general interest, they will be relayed to farmers in the community, so that control measures can be applied. When insecticides are necessary, they can usually be made available before insects have time to destroy crops.

In industrial sections of the country where use of leisure time is becoming a problem, the study of insects and the making of insect collections afford an excellent pastime. The cost of equipment is small, and the insect supply is almost unlimited. In some places county fair boards and local chambers of commerce have provided money to be given as awards for commendable insect collections.

Although some insect collections have sold for large sums of money, such collections represent the lifetime jobs of the persons making

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them. The collector should not be misled by advertisements of certain companies to the effect that they will purchase insects, especially when he is obligated to buy a book of instructions before these companies will buy the insects.

Insect collecting should be started as a hobby, just as the collecting of stamps and other objects, and not as a means of making money. The value of insect collections to scientific institutions depends on the number of authentically identified species the collections contain and the preciseness with which the specimens are mounted and labeled.

The public in general is becoming more conscious of the damage caused by insects and the need for more information on insect control. Members of 4–H clubs who participate in the activities outlined in this manual will learn many things of permanent value to them.

To get the most out of the insect study, one should follow the 3-year program outlined. This will allow time not only for the acquirement of experience, which is the best teacher, but for a review of literature on insects.

All persons cannot become entomologists, but they may acquire knowledge for practical use.

WHY STUDY INSECTS?

Many persons go through life finding little enjoyment in the beauties of Nature and knowing very little about them. If we learn to know more of our natural surroundings, we shall be building toward a fuller life. The human race makes up only a very small part of the living creatures here on earth. Man feels that he has about reached the top of the social ladder, but in reality he still has a long way to go.

HISTORY OF INSECTS

People could profit much by turning to some of Nature's other children who have been struggling along life's pathways for millions of years, possibly long before man came into existence. The lowly insects, as we think of them, were living on the earth more than 40 million years ago. In fossils and in amber, we find preserved insects almost identical with those we can find in our own back yard today. Scientists have found no trace of man that dates back to anywhere near those geological ages.

What is it about the insect that has permitted it to withstand all these centuries while many other forms of animal life have appeared on the earth and after a relatively few years passed out of existence? We see pictures of large prehistoric animals and wonder why, with all the strength they must have possessed, they did not dominate the earth. This process of elimination is still going on, and every few years some form of animal life passes out of existence. Our naturalists today are working hard to perpetuate certain kinds of birds and animals that are almost extinct.

IMPORTANCE OF INSECTS

Insects, however, live on, and today they are man's greatest competitors in his struggle for existence. Insects destroy our crops, they kill our animals, they crumple our buildings, and they actually feed on man himself. In addition, they spread disease germs that

threaten our plants and animals. Some of the diseases carried only by insects have killed more people than have been killed in all wars. However, to give the impression that all insects are pests would be unfair, for most of them are of little or no importance and many, such as the ground beetles, ladybeetles, wasps, and certain flies, are beneficial, as they feed on insect pests. The honeybee makes honey and beeswax, the silkworm makes silk, and many insects pollinate plants. Insects also provide food for birds and fishes.

This manual has been prepared so that young people may have a better understanding of the lives and habits of many of the insects and why they have been able to exist for so many centuries. Remember that even an insect may be justly entitled to a living and do not destroy one wantonly or without good reason. We must, however, be able to protect ourselves against their taking too much of the material we claim. The more of us there are who know our friends and foes in the insect world, the better we shall be equipped to stand our ground against the ravages of our greatest rivals, the insect pests.

Part I.—ACQUAINTANCE WITH INSECTS

[Introduction to first-year work]

What is this creature we call an insect, and how does it differ from other forms of animal life? Insects are animals that in the adult stage have an external skeleton and three definite body regions, the head, thorax, and abdomen. They have three pairs of legs and only one pair of antennae (feelers). They usually have compound eyes and one or two pairs of wings.

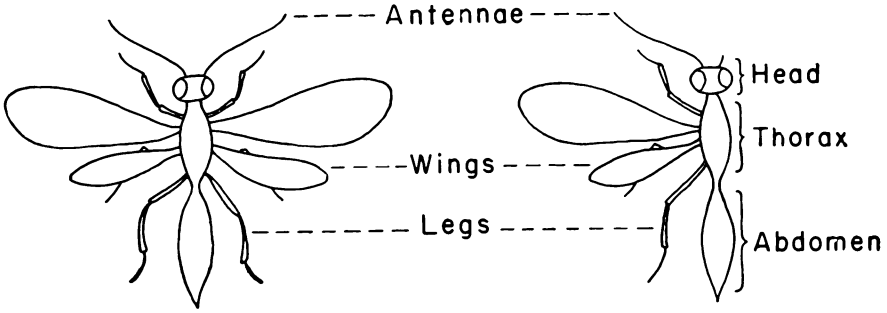

FIGURE 1.—External construction of an insect.

Insects are adapted to a wide range of conditions. Some live in the air and soil, some in plants or animals or their products, and some in the water. Those that live out of the water breathe through small openings along the sides of their bodies, and some of those that live in the water are equipped with gills which enable them to get their air from the water.

There are more kinds of insects than of all other forms of animal life put together. In fact, an entomologist found more than 1,000 different kinds in his small back yard in a suburb of New York City. As there are about 700,000 different kinds of insects known to exist, the need for some form of classification becomes apparent. Entomologists separate them into orders, families, genera, and species. (Each of these classifications further divides the one preceding.) In this manual no more can be done than help to acquaint the reader with the more common orders.

A scientific name, in addition to helping to classify an insect or show its relationship to other insects, aids in designating more clearly the particular insect referred to. There are several insects that have the same common name. For instance, potato beetle is a name which may refer to the Colorado potato beetle, the black blister beetle (old-fashioned potato bug), or the tiny flea beetle; but if we say *Leptinotarsa decemlineata*, it doesn't matter whether we are in the United States, England, or China, the entomologist knows the beetle to which we refer. Let us analyze *Leptinotarsa decemlineata* and see what the words mean:

Leptinotarsa: From leptos, meaning thin, and tarsos or tarsus, meaning part of insect leg.

decemlineata: From deca, meaning 10, and linea, meaning line. Thus we have *Leptinotarsa decemlineata*, an insect with small tarsus and 10 lines on its back. The technical name of an insect often refers to some part of the insect, or to the plant or animal on which the insect feeds.

Insects may have different common names. Take the corn earworm, for instance. In places where tomatoes are grown extensively, this worm is called the tomato fruitworm; in the cotton sections it is called the cotton bollworm, and in corn-growing sections it is referred to as the corn earworm. But if we say *Heliothis armigera*, the entomologist anywhere will know the insect we mean.

No doubt many boys and girls will want to refer to the scientific names of some insects. For this reason, in the discussion accompanying the pictures, on pages 13 to 40, are mentioned the common name, and the names for the order, genus, and species of several of our common insects. It must be remembered that in referring to the scientific name, only the names for genus and species are given.

COLLECTION AND IDENTIFICATION

It is hoped that club members will make an insect collection, and that after a few years each member will have representative specimens of the more important orders of insects and note sheets giving a complete description of each. Beginners should endeavor to have by the end of the first year insects representative of the following eight orders:

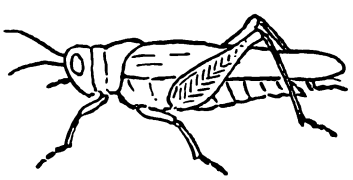

FIGURE 2.—Grasshopper.

ORTHOPTERA.—Orthos (straight), pteron (a wing). Four wings, when present; front wings leathery, straight; hind wings folding fanlike under them. Chewing mouth parts. Antennae and legs usually long. Life changes (metamorphosis) incomplete. Grasshoppers, crickets, katydids, roaches, walking sticks.

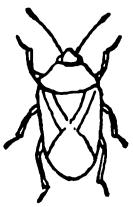

FIGURE 3.—True bug.

HEMIPTERA.—Hemi (half), pteron (a wing). Four wings, when present; front wings leathery at base, forming an × on back when wings are folded. Piercing and sucking mouth parts folding under body. Life changes incomplete. Odor sometimes sickening. Stink-bugs, squash bugs, plant bugs, chinch bugs, and bedbugs.

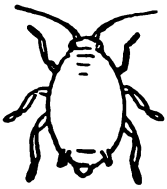

FIGURE 4.—Plant louse.

HOMOPTERA.—Homos (same), pteron (a wing). Winged forms having four wings, front pair clear or leathery and longer and narrower than hind wings; wings folding rooflike over back. Mouth parts for piercing and sucking. Life changes incomplete. Aphids, cicadas, leafhoppers, treehoppers, and scale insects.

FIGURE 5.—Beetle.

COLEOPTERA.—Coleos (sheath), pteron (a wing). Front wings leathery, fitting over hind part of body like a case, meeting in a straight line along center of back; hind wings clear, jointed in middle, folded under front wings when at rest. Mouth parts formed for chewing. Life changes complete. Ladybeetles, potato beetle, leaf beetles, carpet beetles.

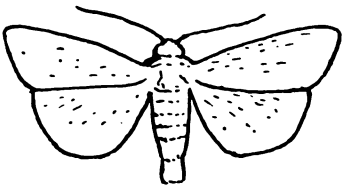

FIGURE 6.—Moth.

LEPIDOPTERA.—Lepis (scale), pteron (a wing). Four similar wings, when present, membranous, but covered with overlapping scales. Mouth parts for sucking. Life changes complete. Butterflies, moths, skippers.

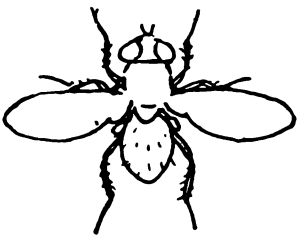

FIGURE 7.—Fly.

DIPTERA.—Dis (twice, from duo, meaning "two"), pteron (a wing). Two clear wings; knobs in place of hind wings. Three distinct body regions. Mouth parts tubular, for sucking, piercing, or lapping. Life changes complete. Flies, mosquitoes, gnats.

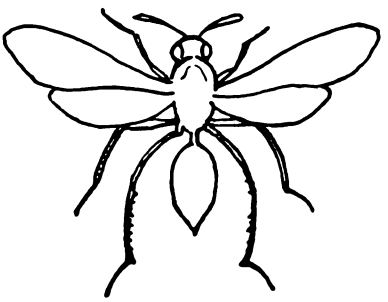

FIGURE 8.—Wasp.

HYMENOPTERA.—Hymen (membrane), pteron (a wing). Four clear wings, when present; few wing veins; hind wings smaller than front wings and often hooked to them. Mouth parts for chewing. Abdomen often with slender waist, females of some kinds with stingers. Life changes complete. Wasps, ants, bees, sawflies.

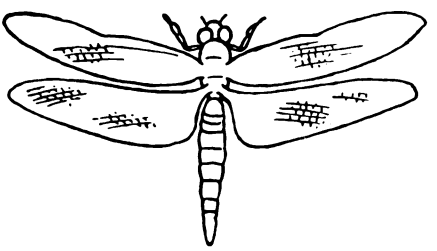

FIGURE 9.—Dragonfly.

ODONATA.—Odous (a tooth). Four long, rather narrow wings, finely netted and either clear or banded, of equal or nearly equal size. Wings with a short, heavy cross vein and a slight notch along front side so that they look as if jointed. Large eyes, head loosely joined to long, narrow body; antennae short. Mouth parts for chewing. Nymphs living in water. Life changes incomplete. Dragonflies, damsel flies.

CALENDAR OF ACTIVITIES, FIRST YEAR

This manual is so outlined that 4–H club members can carry on insect work for 1, 2, or 3 years. To help members get the most out of this insect study, the following calendar outlines the activities for the first year. Similar calendars for the second- and third-year activities appear on pages 46 and 60, respectively. If less than 12 meetings a year are held, two or more activities can be combined in one meeting period.

Meetings	Acquaintance with insects	Page
First, February	Organization. Review introduction to manual	6
Second, March	Outline work for year. Make collection box	6
Third, April	Make collecting net	7
Fourth, May	Make killing jars. Pin insects	8
Fifth, June	Make spreading board. Spread butterflies or moths	9
Sixth, July	Collect and identify insects	9
Seventh, August	Collecting trip. Make butterfly mounts	9
Eighth, September	Fill out note forms. Arrange insects by orders	10
Ninth, October	Exhibit collections. "Wienie" roast	10
Tenth, November	Locate insects in winter quarters	11
Eleventh, December	Reports on work and literature references	11
Twelfth, January	Discussion on life cycle of insects	11

ACTIVITIES FOR FIRST YEAR OUTLINED

The following outline breaks down the calendar of activities for the first year of insect work. It lists some of the equipment necessary and suggests a few steps in procedure for carrying out the work for each meeting of each month.

When entire clubs are engaged in insect work, the work for each meeting can be illustrated by team demonstrations. The introduction and summary for each demonstration will be about the same. In the introduction the demonstrators should tell (1) what is being demonstrated, and (2) what it will be used for. In the summary, they should present briefly the main points in the demonstration to be remembered and ask for questions.

Because the equipment and procedure will vary with each meeting, this outline gives the equipment necessary and a few points on procedure for each meeting.

ORGANIZATION. REVIEW INTRODUCTION TO MANUAL

[First meeting—February]

The county agent or entomologist tells the story of insects—how they cause damage and how they are controlled. Reads and explains the introduction to the manual. Tells how club members can do insect work. The club is organized.

OUTLINE WORK FOR YEAR

[Second meeting—March]

The club president, county club agent, or extension entomologist outlines the work for the year and has club members make a survey of the insect situation before the next meeting. Summary of work for the year is read through.

MAKE COLLECTION BOX

Equipment:

1. Cigar box, 2 by 6 by 8 inches preferred.
2. Piece of double-faced, corrugated cardboard or soft fiberboard.
3. Glue.
4. Moth ball.
5. Common pins.
6. Box or folder of matches.

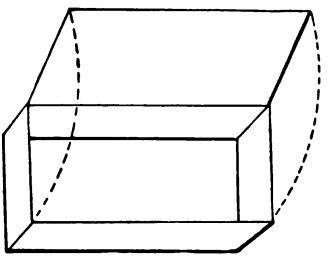

FIGURE 10.—Cigar box.

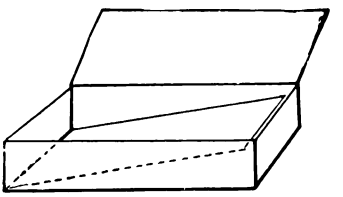

FIGURE 11.—Cigar box equipped for insect collecting.

Procedure:

1. Cut cardboard to fit bottom of box.
2. Smear glue on bottom of box and insert cardboard.
3. Box may be lined with white paper.
4. Heat head of pin from lighted match.
5. Insert hot head of pin into moth ball and cool.
6. Stick moth ball, on pin, into corner of box.

MAKE COLLECTING NET

[Third meeting—April]

Equipment:

1. Small wooden handle about 3 feet long (broom handle).
2. Five feet of heavy, stiff wire (barrel hoops or telephone wire).

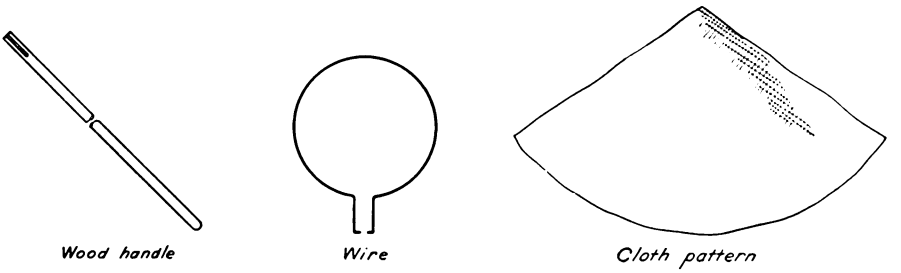

FIGURE 12.—Wooden handle, wire, and cloth pattern for making collecting net.

3. Piece of cloth 3 by 5 feet (mosquito netting or better grade material).
4. Pattern from which to cut cloth.
5. Saw, hammer, brace, small bit, narrow wood chisel.
6. Cord for wrapping wire onto handle.

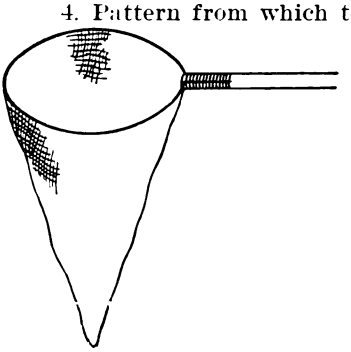

FIGURE 13.—Collecting net.

Procedure:

1. Bend wire into shape.
2. Bore hole and cut grooves in broom handle.
3. Cut cloth and sew it together.
4. Slip bag on wire.
5. Attach wire to handle.
6. Reference: Consult your county agent for additional information.

MAKE KILLING JARS

Fourth meeting—May

Equipment:

1. A 1-pint fruit jar fitted with jar ring and tight lid.
2. Piece of cardboard (double-faced corrugated preferred).
3. Small bottle of carbon tetrachloride. (Carbon tetrachloride cleaning fluids may be used.)
4. About a half cupful of small scraps of rubber from any source, such as old jar rings or inner tubes.

Procedure:

1. Cut cardboard to fit tightly inside jar.
2. Place scraps of rubber inside jar.

FIGURE 14.—Glass jar with tight lid.

FIGURE 15.—Jar charged with carbon tetrachloride.

FIGURE 16.—Killing jar properly labeled.

3. Saturate scraps of rubber with carbon tetrachloride.
4. Pour out excess liquid after rubber becomes saturated.
5. Cover scraps with cardboard disk.
6. Place lid on tight.

If jar is kept sealed tight except when insects are being placed in it or removed from it, the carbon tetrachloride will remain active for a month or more.

To recharge killing jar, remove the cardboard and add more carbon tetrachloride as explained in item 3 of procedure, above. Replace the cardboard disk and the lid.

PIN INSECTS

Equipment:

1. Pins (No. 3 insect pins preferred; common pins may be used).
2. A few freshly killed insects representing each of the five major groups; namely, stinkbug, beetle, bee or fly, grasshopper, butterfly.
3. Spreading board.
4. Labels to be placed on pin with insect.

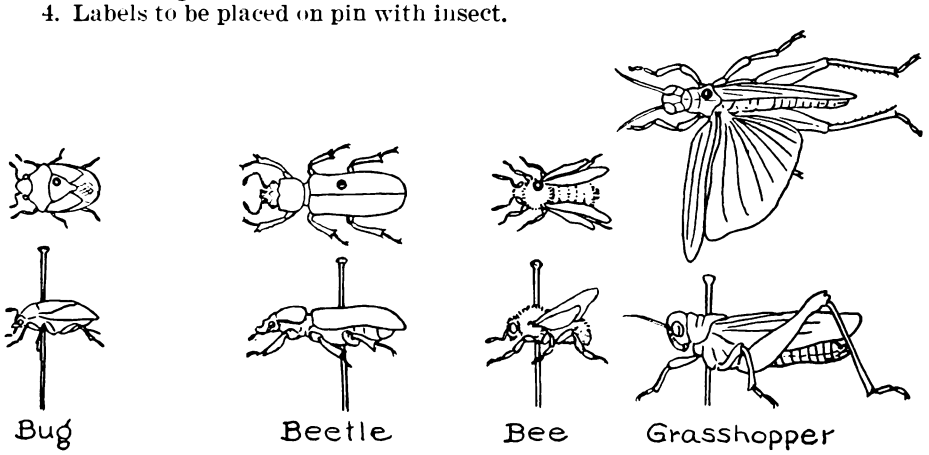

FIGURE 17.—Insects, properly pinned.

Procedure:

1. Pin insects according to figure 17, above.
2. Place on pin, label giving name of insect, name of collector, date when collected, and place.
   a. Instructions: See sixth meeting, calendar of activities, first year.

MAKE SPREADING BOARD. SPREAD BUTTERFLIES OR MOTHS

[Fifth meeting—June]

Equipment:

1. Two strips, ¼ by 2 inches, of softwood 1 foot long.
2. One strip of cork or similar material, ¼ by 2 by 12 inches.
3. Two blocks, ½ by 2 by 5 inches.
4. Small nails, hammer, pins.

Procedure:

1. Nail wooden strips on blocks, leaving them about one-fourth of an inch apart.
2. Nail cork strip flatwise to slats, beneath crack between slats.
3. Pin butterfly before it is dry.
4. Insert pin through cork so that body rests on cork between slats.
5. With point of another pin move wings forward.
6. When wings are spread, place strip of paper across them. Fasten down with pins.
7. Allow butterfly to remain on spreader a few days, or until dry.

FIGURE 18.—Butterfly, spread.

COLLECT AND IDENTIFY INSECTS

[Sixth meeting—July]

FIGURE 19.—Insect in killing jar.

Equipment:

1. Killing jar or bottle.
2. Collecting net.
3. Extra bottle or box for young or soft-bodied forms.
4. State or Government farmers' bulletin on insects.
5. Textbook on insects.
6. Small labels ½ by 1 inch, cut from stiff paper.

Procedure:

1. Collect economic insects from gardens, orchards, or field crops.
2. Observe plant on which each insect is feeding.
3. Kill adult forms only in killing jars.
4. Keep lid tight on killing jar except when inserting or removing insects.
5. Immature insects may be pickled in alcohol or formaldehyde.
6. Compare insects with pictures and descriptions in bulletins and books.
7. Prepare labels (to be placed on pin with insect).
8. On one or more labels have:
   - *a*. Name of insect.
   - *b*. Place where collected.
   - *c*. Date collected.
   - *d*. Name of collector.

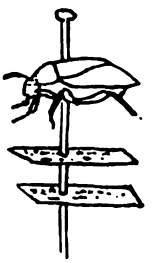

FIGURE 20.—Insect, pinned and labeled.

COLLECTING TRIP. MAKE BUTTERFLY MOUNTS

[Seventh meeting—August]

Equipment:

1. Collecting material.
2. Piece of window glass 4 by 4 inches.

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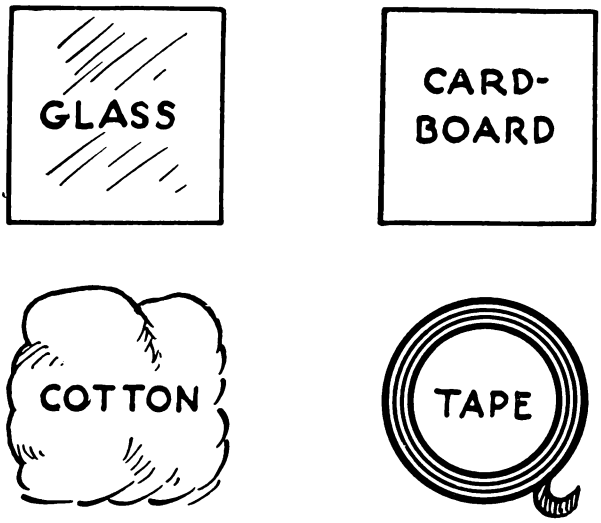


FIGURE 21.—Materials for making butterfly mount.

3. Piece of cardboard, same size as glass.
4. Thin layer of cotton, same size as glass.
5. Picture binding such as passe partout tape.
6. Butterfly with wings spread and dried.

Procedure:

1. Collect insects and note kind of plants on which they are found.
2. Make mount by—

a. Spreading thin layer of cotton on cardboard.
b. Arranging butterfly on cotton.
c. Placing glass over butterfly.
d. Binding edges of cardboard to glass with binding tape.
e. String may be attached for hanging mount, or strip of cardboard may be glued on back of mount as a support.

FILL OUT NOTE FORMS. ARRANGE INSECTS BY ORDERS

[Eighth meeting—September]

Equipment:

1. Note forms, pencils.
2. Insect collections.
3. Reference bulletins.

Procedure:

1. Write notes about insects on forms similar to that shown on page 41.
2. Arrange insects in the collections.
3. Make sure that each insect is properly labeled. Date and locality are important.
4. Insects should be neatly arranged in rows, heads toward back of box.
5. Place insects representing the different orders together—beetles in one place, flies in another, etc.

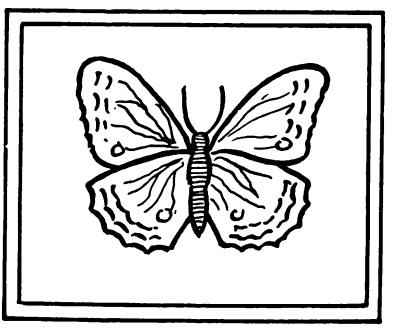


FIGURE 22.—Butterfly in mount.

EXHIBIT COLLECTIONS. "WIENIE" ROAST

[Ninth meeting—October]

Equipment:

1. Insect collections and any notes on insects.
2. "Wienies," cider, marshmallows, etc.

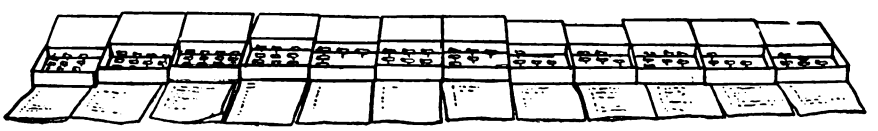


FIGURE 23.—Insect collections arranged for exhibition.

Procedure:

1. Place all insects from a given club in neat order.
2. Refreshments.
3. Program—games, playlets, stunts, etc.

LOCATE INSECTS IN WINTER QUARTERS

[Tenth meeting—November]

Equipment:

1. Notebook and pencil.
2. Bulletins, as an aid in identifying insects.
3. Hoe, pick, or shovel to uncover insects.

Procedure:

1. Locate hibernating insects under loose bark of trees, in crevices in bark, clumps of grass, under rubbish or plant refuse, in soil, etc.
2. Make notes on insects—kinds, when and where found.

REPORTS ON WORK AND LITERATURE REFERENCES

[Eleventh meeting—December]

Equipment:

1. Collection and any notes that member may have.
2. Book, farm paper, newspaper, or bulletin carrying some unusual or interesting story about an insect.

Procedure:

Each club member—

1. Tells name of the insects in his or her collection.
2. Tells what he or she knows about each insect in collection.
3. Names book or bulletin where information was obtained.
4. Tells in his own words an interesting story about an insect, and his source of information.

DISCUSSION ON LIFE CYCLE OF INSECTS

[Twelfth meeting—January]

Equipment:

1. Book, bulletin, or paper giving life history of some insect.

Procedure:

1. Each member reports on life of some insect.
   - *a.* Its name.
   - *b.* The plant or animal on which it feeds.
   - *c.* How it feeds (chews or sucks).
   - *d.* Kind of life cycle, complete or incomplete.
   - *e.* Where it spends the winter.

SCIENTIFIC NAMES OF INSECTS

Some boys and girls may want to know more about the technical names of insects or the relationship of one insect to another. In the description accompanying the pictures, the scientific name of the insect is given. For example, the scientific name of the red-legged grasshopper shown on page 13 is *Melanoplus femur-rubrum*. For classification purposes, other larger divisions such as orders and families are also used. No reference is made to families in the description, but the order to which the insect belongs appears under the discussion of the first insect in the group, if not under each insect.

The following chart shows how the technical name of an insect is used in classification. Remember that in the order Homoptera there are many more families, genera, and species than are shown here. In the family Aphiidae (plant lice) five genera are listed, each of which has certain characteristics in common. One finds on close examination, however, that in each of the genera are individuals differing in character, so these are placed under species, as we see, for example, under "Aphis."

The order Homoptera subdivided into some of its families, genera, and species

Order	Family	Genus	Species
Homoptera	Aphildae	*Aphis*	*gossypii.*
			maidi-radicis.
			pomi.
			rumicis.
		Anuraphis	*roseus.*
		Brevicoryne	*brassicae.*
		Eriosoma	*lanigerum.*
		Myzus	*cerasi.*
	Cicadidae	*Magicicada*	*septendecim.*
	Cicadellidae	*Empoasca*	*maligna.*
		Erythroneura	*comes.*
	Membracidae	*Ceresa*	*bubalus.*
	Coccidae	*Aspidiotus*	*perniciosus.*
		Chionaspis	*furfura.*
		Lepidosaphes	*ulmi.*
		Pulvinaria	*vitis.*

Thus it can be seen that the cotton or melon aphid (*Aphis gossypii*) belongs to the family Aphiidae and the order Homoptera.

FURTHER AIDS TO IDENTIFICATION

Anyone who is sufficiently interested in insects to want to make a collection, will want to know the names of those collected. Because there are so many different kinds, it is almost impossible to prepare a simple key for identification that the average person can use.

The best that can be hoped for in this publication is to acquaint club members with the larger groups of insects such as the orders. In some cases it is well to know the families, and, where the insect is of major importance, it is very helpful to be able to identify the species.

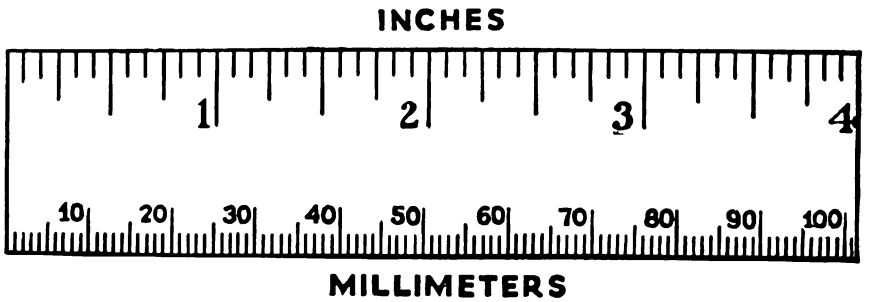


FIGURE 24.—Rule for measuring insects.

Instead of the usual key, a number of pictures have been used to assist in identification. In some cases the picture of a single insect is shown to represent an entire order, and in other instances the pictures represent the family also. Remember that there may be a thousand or more insects that are very closely related to the insect shown in the picture, and in many cases closely resemble it. Textbooks and bulletins may be used to help further in identification.

Since a means of measuring is not always available, the rule sketched above should be useful. The upper portion is divided into inches, and the lower portion into millimeters.

ORTHOPTERA (GRASSHOPPERS AND OTHERS)

Grasshoppers.—A large group of the order Orthoptera is represented by the grasshoppers. They vary greatly in size. Most grasshoppers are greenish and yellowish gray in color. Their rather long hind legs, thickened at the base, equip them for jumping. The mouth parts are of the chewing type, and these insects destroy many kinds of field crops, vegetables, and weeds; at times they also eat the leaves and bark off trees. Most of the grasshoppers overwinter in the ground in the egg stage. These insects have changes in form during the life cycle. When first hatched, they are very small. They shed their skins several times during life, each time coming out in a larger skin and a little more closely resembling the adult form which has four wings. The hind wings are folded fanlike under the rather long, narrow forewings. Since these insects destroy crops, they most certainly are pests. Grasshoppers may be controlled by cultural practices, but when they become abundant, it is necessary to apply insecticides. The scientific name of the grasshopper shown here is *Melanoplus femur-rubrum*. (The length of this species is approximately 1 inch.)

FIGURE 25.—Grasshopper.

Crickets.—Nearly every boy and girl has heard the chirping of the cricket although they may never have seen the little insect, about five-eighths of an inch long, that does the chirping. Crickets vary widely in shape and structure. Most of them are black in color. The one shown here is the large, black field cricket (*Acheta assimilis*). The four wings fold over the back but are seldom, if ever, used for flying. Like other Orthoptera, the crickets have incomplete life changes and overwinter mainly in the egg stage in the ground, or in the nymphal stage in protected places. They have chewing mouth parts and feed on a wide variety of substances. This species sometimes causes damage by eating the twine from bundles of grain.

FIGURE 26.—Cricket.

Katydids.—No doubt many boys and girls in the Northern States have heard the remark "It will be only 6 weeks until frost," because some member of the family has heard the familiar katydid. The sound of this insect is much easier to detect than the insect itself, because its green color makes it difficult to see amidst green foliage. Like the grasshopper and the cricket, the katydid belongs to the order Orthoptera and has incomplete life changes. It winters in the egg stage. The eggs are often mistaken for some kind of scale insect because of their peculiar shinglelike arrangement along the margins of leaves or along twigs. The large angular-winged katydid (*Microcentrum retinerve*) is about 2 inches long. It has chewing mouth parts and feeds mainly on the

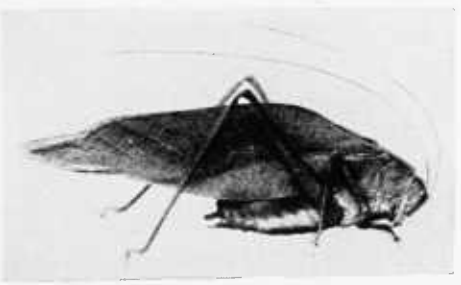


FIGURE 27.—Katydid.

leaves of trees. It has four rather large wings folded over its back. This insect, like the grasshopper, can crawl, jump, or fly. The katydid is seldom of economic importance.

Tree crickets.—In the order Orthoptera are a number of small, pale-green insects, about three-fourths of an inch long, known as tree crickets (*Oecanthus spp.*). They have chewing mouth parts and feed on a wide range of materials, including the leaves, blossoms, and sometimes the ripening fruit of plants, or on weakened members of their own kind. Like most other Orthoptera, tree crickets have four wings. The eggs of tree crickets are deposited in the twigs or canes of plants, where they remain over winter, and the egg punctures made in the stems cause this insect to be considered a pest of raspberry and similar small fruits. Stomach poisons will kill the nymphs, and burning the canes containing the eggs will destroy them.

FIGURE 28.—Tree cricket.

Mantids.—Not all Orthoptera are injurious. The mantids are beneficial because they feed on other insects, many of which are pests. Mantids can be easily distinguished from other Orthoptera by the much elongated thorax or waist part of the body, and by the large front legs, which are fitted for grasping their prey. The four wings usually are folded back over the hind part of the body. The total length of the body of the species here illustrated is approximately 2½ inches. These insects have incomplete life changes. The eggs are laid in clusters, usually covered with dried froth, on branches and twigs of trees or shrubs and remain there through the winter. The next spring the eggs hatch, and the young mantids start their beneficial work of destroying other insects. Since the mantids are friends of man, we need not worry about control measures. The one shown here is *Stagmomantis carolina.*

FIGURE 29.—Mantid.

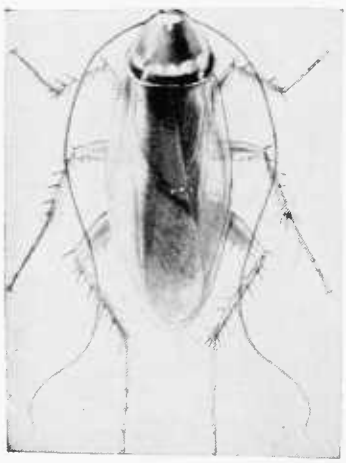


FIGURE 30.—Roach.

Roaches.—The cockroaches make up another family of the Orthoptera. Two kinds are rather common over the United States, the small German roach and the larger American roach. These insects prefer to remain in dark places, although at times they do venture into the light. Their very flat bodies permit them to get into extremely narrow cracks. These insects have four wings, but they are seldom used. They feed primarily on human foods and waste food products. Cockroaches have incomplete life changes. After the eggs hatch, the nymphs shed their skins several times and finally reach the adult stage. Some roaches live in the woods in the loose bark of trees or logs,

but those most commonly seen are around the home. In our modern houses heated the year round, all stages of the roach may be found at any time during the year. These insects are pests, not so much because of the food they destroy as of the filth associated with them. To control roaches, spray or dust residual[1] insecticides or stomach poisons into cracks and crevices where the insects hide and into places where they develop. Thorough application is necessary to obtain satisfactory control. The roach shown here is *Periplaneta americana*. It is about 1⅛ inches long.

Walking sticks.—Another insect that belongs in the order Orthoptera very much resembles a small slender twig. Members of this group are called walking sticks, and our common species is *Diapheromera femorata*. They range in length from 2⅝ to 4 inches, are often grayish in color, and frequently feed on the foliage of trees and shrubs, but seldom become abundant enough to warrant control measures. The eggs are simply dropped to the ground from where the insect is feeding. Ordinarily, they do not hatch until the following spring. Sometimes they remain dormant an additional year before hatching. The young walking sticks crawl to their food plants and complete their development.

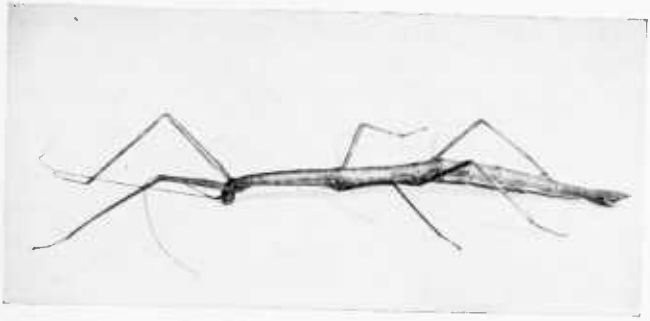


FIGURE 31.—Walking stick.

HEMIPTERA (TRUE BUGS)

The order Hemiptera comprises a large group of insects that vary considerably in general appearance. Many have a rather unpleasant odor, and one smaller group of this order is referred to in many localities as the stinkbugs.

Stinkbugs.—True stinkbugs vary considerably in size and color, but all present the five-sided appearance with the small triangular area in the center of the back. The adults have four wings; the fore pair is half leathery and half clear wing, hence the name of the order Hemiptera, meaning half wings. The adults fly, but the nymphs are limited to crawling. The suggestion in the word "nymph" indicates that this insect, and all insects of the order Hemiptera, have incomplete life changes. The mouth parts are fitted for sucking. The stinkbug group feeds on a wide variety of plants. Some, that feed on insect pests, are beneficial. The insect pictured here, known as the southern green stinkbug (*Nezara viridula*) is about five-eighths of an inch long; it feeds on cotton and many vegetable crops. It hibernates as an adult in rubbish. It is often a serious pest and is very difficult to control, as it does not readily succumb to the usual insecticides. If obtainable, sabadilla dust gives good control.

FIGURE 32.—Stinkbug.

[1] For more on the use of residual sprays, see page 57.

Harlequin bug.—The harlequin bug (*Murgantia histrionica*), order Hemiptera, is about three-eighths of an inch long and is black with large orange, red, and yellow markings. It is a sucking insect, and has four wings. The adults fly, and both adults and young crawl readily. The adults and the full-grown nymphs are active throughout the winter when the days are warm. On cold days, or in the northern limits of their distribution, the bugs hide in old cabbage plants, weeds, and other debris. This pest is rather severe in the Southern States but can be partially controlled by field sanitation, trap crops, cultural practices, and sprays such as rotenone extracts. If obtainable, sabadilla dust gives good control.

FIGURE 33.—Harlequin bug.

Water bug.—Occasionally around electric lights one finds a grayish-brown bug about 2 inches long. This insect is often called the giant water bug or electric-light bug. The specific name is *Lethocerus americanus*. It has four wings; flies; overwinters as a nymph or adult in trash, mud, or pools of water; has incomplete life changes, and may be considered a pest when it attacks fish, snails, etc., in ponds and aquariums. The larvae of this insect are water loving and feed on various forms of water life. This insect belongs to the order Hemiptera.

FIGURE 34.—Water bug.

FIGURE 35.—Masked hunter.

Masked Hunter.—Another of the true bugs is the masked hunter (*Reduvius personatus*). It is from one-half to three-fourths of an inch long and is black, has sucking mouth parts, four wings, and can fly. This insect is beneficial because it feeds on various household and cereal insects. It overwinters as a nymph or adult under trash and the like. The life changes are incomplete. This insect belongs to the order Hemiptera.

Squash bug.—Practically every grower of squash has seen a rather large, elongated, dark-gray insect, and oftentimes clusters of small lighter gray spiderlike pests feeding on his squash. These insects, like all other insects of the order Hemiptera, have incomplete life changes and sucking mouth parts. The adult insect is about one-half an inch long. The adults of this group have four wings and fly readily when disturbed. Both the adults and the nymphs feed on the leaves, fruits, and vines of squash and related plants. The adult insects overwinter beneath rubbish and loose bark of logs. They may be partially controlled by use of contact sprays and cultural practices. If obtainable, sabadilla dust gives good control. The common squash bug shown here is *Anasa tristis*.

FIGURE 36.—Squash bug.

Plant bugs.—Certain other members of the order Hemiptera that rather closely resemble the true stinkbug, except that they usually are smaller and a little more elongated, are the plant bugs. These insects have incomplete life changes. They have sucking mouth parts and four wings. The adult can fly readily, and both the adults and nymphs crawl. This group feeds on the leaves and small stems of weeds and on many crops. Plant bugs spend the winter as adults beneath rubbish. Most of them are pests and are controlled by cultural practices. However, DDT dust or spray gives good control. The common tarnished plant bug (*Lygus oblineatus*) shown here is brownish yellow in color, is marked with black, and is about three-sixteenths of an inch long.

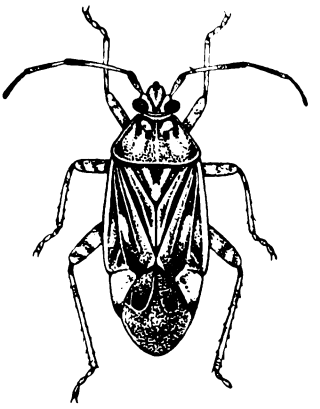


FIGURE 37.—Plant bug.

Chinch bug.—In the grain belt, when the chinch bug is mentioned, farmers' thoughts at once go to the bug that destroys their grain crops. There are several species of chinch bug, but the most destructive one is *Blissus leucopterus*. This hemipteron has incomplete life changes. It is about three-sixteenths of an inch long. The adults have four white wings and are black with silvery-gray hairs. The nymphs are reddish in color. They suck the juices from stems of grain, and, although small, quite often build up such enormous numbers that they cause complete destruction of large portions of grainfields. They overwinter preferably in bunch grass and other grasses, but will survive under leaves on the ground in woodland, under loose bark of trees, and in similar protected places. Control measures are chemical barriers, cultural practices, and the planting of less favored hosts.

FIGURE 38.—Chinch bug.

Bedbug.—Another one of the Hemiptera which is a notorious pest is the bedbug (*Cimex lectularius*). This insect has incomplete life changes. In the adult stage it is about three-sixteenths of an inch long. It is reddish brown, has sucking mouth parts, and is wingless. This means that its only mode of travel is to crawl or be carried by man or moving objects. The bedbug feeds on man, chickens, and many other warm-blooded animals. In the South or in well-heated homes in the North these bugs continue to feed throughout the winter. All stages of the insect may be found the year round. To control bedbugs, spray a 5-percent DDT solution on infested mattresses, springs, bedframes, and on nearby furniture and walls.

FIGURE 39.—Bedbug.

HOMOPTERA (BUGS)

The order Homoptera consists of a group of insects closely related to the Hemiptera. In fact some entomologists consider them a suborder of the Hemiptera.

Cicadas or "locusts."—Almost every autumn one hears shrill noises in the trees. The maker of these shrill noises is called the dog-day cicada or harvest fly. There are other similar insects, however, that appear earlier in the season. Dog-day harvest flies have piercing mouth parts and can suck the juices from plants. The adults are about 1¼ inches in length and have four clear wings that fold shedlike over the back. They have incomplete changes in the life cycle. Some of these species require 4 years to round out their life cycle; others require a longer period. In fact, one species of cicada requires 17 years. The name "locust" is often applied to these Homoptera, but incorrectly. The principal injury is caused by the adult, which punctures the twigs of trees in order to deposit its eggs inside. This injury is especially noticeable when great swarms of the 17-year cicadas appear. The insect shown here is the periodical cicada (*Magicicada septendecim*).

FIGURE 40.—Cicada.

Leafhoppers.—Quite often annual plants begin to show signs of stunted growth from no apparent cause, but when disturbed, tiny insects can be seen flying from the plants. These insects, often incorrectly called white flies, are really leafhoppers. The tiny beak through which they suck plant juices causes a mottled or stippled effect on the leaves of grapes and many hardy plants. Some kinds of leafhoppers also carry plant diseases from one plant to another. Leafhoppers vary considerably in size and color, but all are long and narrow with four wings, also rather long and narrow, folded over the back when at rest. Leafhoppers have incomplete life changes. The nymphs are difficult to see because they are very active and usually, when the plant on which they are feeding is disturbed, scurry to the opposite side of the leaf, away from the observer. The observer, when fortunate enough to see a nymph crawling, will note that it usually does not run straight forward but somewhat sidewise. Leafhoppers feed on a wide variety of plants. In the South they are active throughout the season. In the Northern States some overwinter as adults and some as eggs. The insect pictured here, the potato leafhopper (*Empoasca fabae*), is approximately one-eighth of an inch long. It may be controlled by spraying with DDT, bordeaux mixture, or pyrethrum, or by dusting with sulfur.

FIGURE 41.—Leafhopper.

FIGURE 42.—Mealybug.

Mealybugs.—Anyone who has attempted to grow house plants, especially coleus, has become familiar with a downy growth which occurs along the main stem, but too few people realize that this down covers an insect, the mealybug. Mealybugs vary considerably in size and structure and feed on a wide variety of host plants. Although very tiny, the insects are able to insert their sucking beaks into the tender parts of the leaves and stems of plants. They are practically all wingless, and both adults and young are obliged to

crawl. They prefer warm weather and spend the winter in all stages on the host plant. The life changes are incomplete. Mealybugs often become serious pests, but can be controlled by washing the host with water under pressure, or by contact spray or fumigation, depending on the plant on which they are feeding. A common mealybug (*Pseudococcus citri*) is the one shown here. It is about three-sixteenths of an inch in length.

Scale insects.—Practically every person longs for a house in which he can eat and sleep and possibly rest, but certain tiny insects build a house in which they spend their entire life. Scale insects are the ones referred to. Many people have seen the little houses, about one-eighth of an inch wide, under which the insects live, but few have ever seen the insects themselves because they are so tiny. The shape or style of the house often assists in distinguishing the name of its inhabitant. For instance, there is an insect which builds a house somewhat resembling a tiny oystershell, and for this reason it is called the oystershell scale. The scale insect pictured here, which always presents the appearance of a small nipple, is called the San José scale (*Aspidiotus perniciosus*) because it was accidentally introduced at San Jose, Calif. Scale insects in feeding suck the juices from many kinds of plants. The San José scale spends the winter on its host plant and attempts to live over in all stages, but most of the survivors are second-stage nymphs. During the first few hours of its life, the young scale insect crawls about on the plant, but soon settles down and starts to secrete a scalelike covering. Once established, the female never leaves the scale. The male insects, however, have wings and come out at certain seasons of the year, depending on the locality. Scale insects become very destructive at times. Some are controlled by contact sprays and others by fumigation.

FIGURE 43.—Scale insect.

COLEOPTERA (BEETLES)

One of the largest orders of insects is the Coleoptera to which belong the beetles, all of which have complete life changes. They usually have leathery forewings, and the hind wings when present and not in use are folded up under these leathery wings. Many of the beetles are severe pests.

Ladybeetles.—Very common representatives of this order are the ladybeetles. However, most ladybeetles are beneficial because they feed on other insects. The species vary widely in color, are usually spotted, and have a somewhat oval body about one-fourth of an inch long. Ladybeetle larvae are somewhat lizardlike and usually have short tufts of spines over the body. These insects abound in colonies of plant lice. They overwinter in the adult stage; their four life stages are spent above ground. The little friend shown here is the convergent ladybeetle (*Hippodamia convergens*).

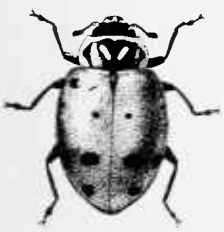


FIGURE 44.—Ladybeetle.

Mexican bean beetle.—In certain parts of the country bean growing is difficult because of a little black-spotted beetle, approximately one-fourth of an inch in length, that chews the leaves of bean plants. Like the other beetles, or Coleoptera, it has two pairs of wings, the fore pair leathery and the hind pair clear. The adults are hemispherical in shape, and coppery brown in color with black spots; the larvae are bright yellow with many forked spines on their backs. The adults overwinter in protected places. Most of the ladybeetles are beneficial, but this one, the Mexican bean beetle (*Epilachna varivestis*), is a pest. It can be controlled with derris or cube dusts or sprays.

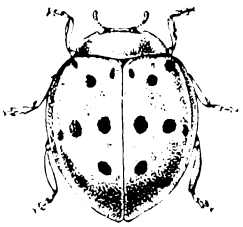


FIGURE 45. — Mexican bean beetle.

Colorado potato beetle.—What boy or girl in most parts of the United States, when visiting a potato patch, has not, at some time or other, seen a yellow and black striped beetle and a small, soft-shelled, brick-colored grub with black spots along its sides, feeding on the potato leaves? This is the Colorado potato beetle. The adult is about three-eighths of an inch long. It has five black lines on each wing cover and black spots on the other part of the body. Of its four wings, the fore or outer are leathery, and the under wings are veinous and fold beneath the leathery wings when the insect is not in flight. The potato beetle overwinters in the adult stage in the ground, and in the spring flies to potatoes or certain closely related plants and starts chewing the leaves. Soon after the adults appear, clusters of orange-colored eggs may be found on the under side of the leaves. The grubs which hatch from these eggs also feed on potato foliage, and, when growth is completed, burrow into the ground and go into the pupal stage, later to emerge as adults. There may be two generations a year in some sections. DDT, paris green, or lead arsenate is dusted or sprayed on the potatoes to control this beetle. The scientific name of this insect, which belongs to the order Coleoptera, is *Leptinotarsa decemlineata*.

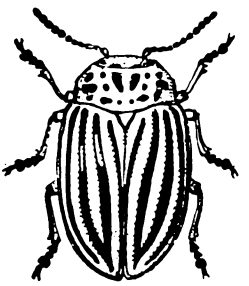


FIGURE 46. — Colorado potato beetle.

Spotted cucumber beetle.—Rather early in the spring in the most northern parts of this country there appears on beans, cucumbers, and various other plants, an elongated, greenish-yellow beetle about one-fourth of an inch in length. The head and legs are black. Because of 12 black spots on its back, 6 on each wing cover, and because it chews holes in the leaves of very small cucumber plants, the adult of this insect is called the 12-spotted cucumber beetle. The larva feeds to a large extent on corn roots, and in this stage it is known as the corn rootworm. This insect overwinters in the adult stage. The eggs are laid just beneath the surface of the soil in the early summer. Because the larvae feed on a great number of the roots of plants belonging to the grass family, and the adults on a wide variety of plants and flowers, the damage to any

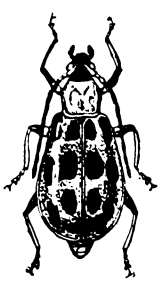


FIGURE 47.—Spotted cucumber beetle.

one plant usually is not serious. Control of the spotted cucumber beetle on most crops is difficult, but on such plants as melons damage can be prevented by means of treatment with arsenicals. This insect belongs to the order Coleoptera; its scientific name is *Diabrotica undecimpunctata*.

Ground beetles.—Among the beetles is another family that is mostly beneficial. These are the ground beetles, so named because many of them have the habit of running around over the ground in search of food. Most species are shiny black with long legs, but a few are blue, green, or brown in color. Both the adults and larvae of the ground-living species hide under stones and debris during the day and come out at night in search of food, which for the most part consists of other insects. The beetle shown here, however, is an active tree climber; it is *Calosoma scrutator*, known as the caterpillar hunter. It is about 1¼ inches long. The wing covers are green with rosy metallic margins. Like the other beetles, both the adults and larvae have chewing mouth parts. The adults have four wings, the front pair leathery and completely covering the abdomen, and the hind pair clear. When at rest, the hind wings are folded up under the forewings. Although it more commonly moves about on foot, this beetle can fly. It overwinters as adult or pupa underground.

FIGURE 48.—Ground beetle.

Tiger beetles.—Along streams and sandy shores one often finds insects about half an inch long that run very rapidly, and fly to escape capture. They are called tiger beetles. These beetles vary greatly in color, some having brilliant metallic hues. The tiger beetle shown here, *Cincindela tranquebarica*, is about half an inch long, brownish with whitish bands, and has chewing mouth parts and four wings. It feeds on various small insects and other small animals. It has complete life changes. Both the adult and larva hibernate in holes in the ground. Since this beetle feeds on other insects, it may be considered beneficial.

FIGURE 49.—Tiger beetle.

June beetles.—During the early part of the summer there is an insect that flies clumsily about, knocking itself against screens, lights, and the walls of houses. Close examination reveals that it is a rather stout, dark-brown to light-reddish colored beetle, ranging from ⅝ to 1 inch in length, with four wings, the fore pair leathery and the hind pair clear. This insect feeds on the leaves of various trees and shrubs. The larva of the June beetle is the white grub that abounds in the soil, where it feeds on the roots of plants. It hibernates in the ground, usually lives over two full winters, and pupates late in the summer. The adults emerge and lay eggs late in the spring or early in the summer of the following year. Cultural practices assist in the control of the grubs. The June beetle shown here belongs to the order Coleoptera, and is *Phyllophaga drakei*.

FIGURE 50.—June beetle.

Click beetles.—Click beetles are familiar to almost any person who has had anything to do with insects. This little elongated beetle has a body apparently divided into two parts only, the head being rather indistinct. When the insect is placed on its back it has the ability to flip itself into the air, and, after several attempts, alight on its feet. Click beetles vary considerably in size, from ¼ of an inch to 2 inches. The larvae are called wireworms. They feed on the roots and in the stems of various plants. Some of these insects complete their life cycle in 1 year, but other kinds may require several years. The scientific name of the insect pictured here is *Melanotus communis*, order Coleoptera. DDT or ethylene dibromide used in the soil controls wireworms.

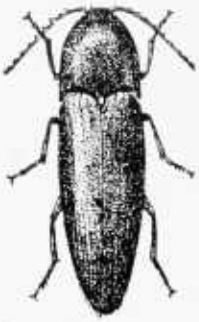


FIGURE 51.—Click beetle.

Locust borer.—Among the beetles are some with very long antennae. These are called longhorn beetles. Most members of this group have elongated bodies ranging in length from ½ inch to 2 inches. The adults are rather strong fliers and swift runners. The larvae are borers and live within the woody parts of trees and shrubs or beneath tree bark. The species shown here is the locust borer, *Cyllene robiniae*, a black beetle with yellow markings. It is about five-eighths of an inch long. The adults may be found basking in the sun on locust trees during September. They feed on the flowers of goldenrod, and the larvae live inside locust trees. These beetles have complete life changes and overwinter in the larval stage in the inner bark, where they have been feeding. They bore deep into the wood during the following spring and summer and cause serious damage to locust trees, especially those of low vigor. This insect belongs to the order Coleoptera. DDT emulsion prevents attack.

FIGURE 52.—Locust borer.

Flatheaded borer.—There is another group of insects that are fairly robust. They have a rather uniform width of body except for the hind third, which tapers somewhat abruptly. Most of these dark-bronze-, brassy-, or coppery-colored beetles are commonly called buprestids. Like all the other Coleoptera, they have chewing mouth parts in both the adult and larval stage. The larvae are wood-boring insects and feed on many kinds of trees. They are decidedly segmented, and their broad, flat heads are about twice as wide as the rest of the body. There is usually only one brood each season. Insects of this type have difficulty in establishing themselves in healthy or vigorous growing trees, but following drought or weakening of the trees from other causes these borers do become established, and control measures are necessary. Clean up and burn all infested trees and branches during April and May. Younger trees may be protected by wrapping with burlap or building paper. The insect

FIGURE 53.—Flatheaded apple-tree borer.

shown here is the adult of the flatheaded apple-tree borer (*Chrysobothris femorata*). It is about one-half an inch long.

Granary weevil.—There is a weevil, rather elongated—about one-eighth of an inch in length—with a long nose, and chestnut brown in color. The size of this insect may be compared to the grain of wheat upon which it rests. This weevil lives indoors and attacks various kinds of stored grains, often doing considerable damage. The chewing jaws of the adults are located at the end of the long, snoutlike head. Hind wings or the ones used in flight are absent, so that the insect can move about only by crawling. Like all other Coleoptera, the weevils have four stages in their life cycle—egg, larva, pupa, and adult. This insect may have several generations a year, depending on the temperature. Fumigation and residual sprays give the most effective control. The scientific name of this insect is *Sitophilus granarius*.

FIGURE 54.—Granary weevil.

Bean weevil.—Entomologists are often asked during the winter or early in the spring for information about infestations of a rather small insect about one-eighth of an inch long discovered flying about the house and windows, or perhaps by some housewife when preparing dry beans for cooking. This insect has a body that tapers sharply to the head, four wings, and a few white markings on its back. The adults fly rather readily to the green beans in the field and lay their eggs in the pods. Soon after hatching, the larvae burrow inside the bean and continue to develop with it. Small circular holes often seen in dry beans indicate that the beans have been infested and the weevils have left the bean through these holes. When the dry beans are placed in storage, if the weather is warm, the insects continue to breed all the year through, but when the weather is cold the larvae remain inactive. The bean weevil belongs to the order Coleoptera, and is called *Acanthoscelides obtectus*. It may be controlled by fumigation or heating.

FIGURE 55.—Bean weevil.

LEPIDOPTERA (BUTTERFLIES AND OTHERS)

Where is the boy or girl who never chased a butterfly? But did this boy or girl ever consider that the butterfly came from a small worm, or larva as the entomologists call it? Butterflies, moths, and skippers have a great deal in common. Their life cycles are the same in that they consist of four distinct stages, the egg, the caterpillar (or feeding stage), the pupa (or resting stage), and the adult butterfly or moth (the reproducing stage). The butterfly, pupa, and larva are quite unlike one another in appearance. This group of insects carries the name "Lepidoptera," which means "scale wings," and everyone who has handled a butterfly or moth knows that the four wings are covered with a fine scaly powder which, when brushed off, leaves a clear wing. The butterflies and moths have sucking-type mouth parts, but the young, or caterpillars, have chewing mouth parts.

Cabbage butterfly.—Possibly one of the most common of these butterflies is the little white cabbage butterfly, which has a wing

expanse of about 1¼ inches. The tips of the forewings are black. The female butterfly has two black spots and the male, one black spot on each forewing. The hind wing of each sex has a single black spot on the outer front margin. The eggs are very small and easily overlooked. The larva is a velvety-green caterpillar found on cabbage and related plants. When the larva finishes feeding it forms a pupa, or chrysalis, on the leaves where the caterpillars have fed. Cabbage butterflies have three or more generations each year, depending on the locality. They overwinter in the pupal stage. The caterpillars cause considerable damage to cultivated cabbage and related crops, and derris and cube powders are used to control these pests. The technical name of the cabbage butterfly is *Pieris rapae*.

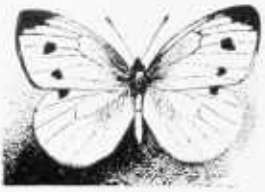


FIGURE 56.—Cabbage butterfly.

Swallowtail butterflies.—Butterflies of another group, and of much larger size than the cabbage butterflies, have long tails on the tips of the hind wings and are therefore called swallowtail butterflies. The different kinds of these butterflies feed on various plants. The large black butterfly pictured here is the one whose larva feeds on celery and related plants. It has a wingspread of about 3 inches. The spots along the margins of the wings are yellow instead of white as indicated in the picture. Like all other butterflies, this one has four wings. In the adult stage it has sucking mouth parts, but the caterpillars have chewing mouth parts and sometimes cause damage to cultivated celery, parsley, and related crops. Hand picking these caterpillars would give control, although under some conditions poison application may be necessary. There are two or three generations each year, and the winter is passed in the pupal stage. Most of the swallowtail butterflies carry the name *Papilio*, and this one is called *Papilio polyxenes*.

FIGURE 57.—Swallowtail butterfly.

Monarch butterfly.—Throughout much of the summer one sees large reddish-brown butterflies. Their wings have black veins and borders, and in the borders are many small white spots. The wingspread is from about 3½ to 4 inches. The butterflies have sucking mouth parts and sap the juices from flowers. The larvae feed on the leaves. Until fairly recent years it was not known that these butterflies moved north in the summer and south in the winter, but now large droves have been located moving southward in much the same fashion as do wild birds. They remain throughout the winter in the hedges or other sheltered places in the South. They have complete life changes. Butterflies are of questionable importance, but if the larvae should build up

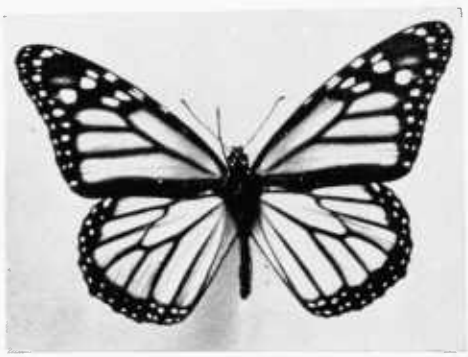


FIGURE 58.—Monarch butterfly.

to destructive numbers stomach poisons will kill them. The scientific name of the butterfly shown here is *Danaus plexippus*. This insect belongs to the order Lepidoptera.

Cecropia moth.—An insect frequently observed is the Cecropia moth. This moth is also very large, with a wing expanse of 5 to 6 inches. It is brown in varying shades, and each of the four wings bears, near the center, a crescent-shaped white spot bordered with red. This moth has sucking mouth parts. The larva is covered with knoblike spines and is of a delicate, dull bluish-green color. The moth overwinters in a rather large grayish cocoon attached to the branches of trees and shrubs where the larva has fed. A cocoon is often taken into a building and the Cecropia moth allowed to emerge in captivity.

FIGURE 59.—Cecropia moth.

The life changes of this insect are complete. It is of questionable importance. This moth belongs to the order Lepidoptera. The scientific name of the insect shown here is *Samia cecropia*.

FIGURE 60.—Regal moth.

Regal moth.—The entomologist's attention is often called to some ugly, rather large, spiny caterpillar, the larva of the royal walnut moth, or regal moth (*Citheronia regalis*). It is one of the largest of its group and has a wingspread of 4 to 5 inches. It is reddish brown with yellow spots. Like other Lepidoptera, this insect has four wings. The larva feeds on the leaves of shrubs and trees and in some regions is known as the hickory horned devil. This insect overwinters as a pupa in the soil and has complete life changes. It is of questionable importance.

Imperial moth.—Another closely related species is the imperial moth (*Eacles imperialis*). This moth rivals the regal moth in size with a wing expanse of 4 to 5 inches. It is pale yellow, banded and speckled with purplish brown, and the wings have lilac-colored bases. The larva of this insect bears rather short, spiny horns on the head end of the body, and feeds on the leaves of shrubs and trees. The moth has four wings and sucking mouth parts. This insect overwinters as a pupa in the soil. It is of questionable importance.

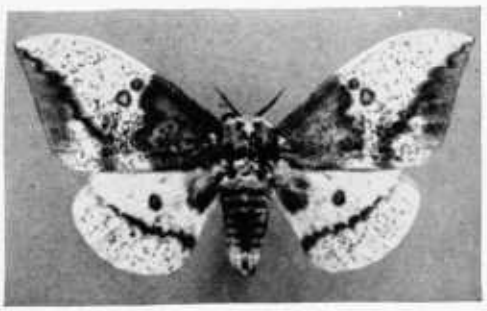


FIGURE 61.—Imperial moth.

Hawk moths.—Certain insects resemble the hummingbird in that they hover around flowers and suck the nectar from deep bell-shaped

flowers. The adults of this group of Lepidoptera are called hawk moths. These insects have rather heavy bodies and four wings, the hind pair being much shorter than the fore pair. The larvae of this group of moths are rather large and have a taillike horn at the end of the body. When disturbed these larvae throw their heads back almost at a right angle and remain in that position. Both the adult and larva of the different species of hawk moths vary considerably. The species shown here is *Protoparce quinquemaculata*, and is the parent of one of the large, green hornworms that feed on the foliage of tobacco, tomato, and certain other plants. It is possibly the most common and most destructive form. This moth is ash gray in color with darker markings, and its wing expanse is from 4 to 5 inches. This species overwinters in the earth in the pupal stage. The worms can be hand-picked and killed, or killed by applying a poison dust or spray to the food plant. Tomatoes in fruit should not be sprayed with poisons. This species feeds on tobacco, tomatoes, or potatoes.

FIGURE 62.—Hawk moth.

Carpenter worm.—Orchardists often find rather large holes in the branches or trunks of their trees, and when the holes are opened the larvae, or young, of the carpenter moth are found. This moth has a wing expanse of from 2 to 3½ inches; the wings are mottled gray, the hind wings of the male being yellow to orange lined with black. The mouth parts are absent or vestigial. The life changes are complete. In many sections this insect is a pest. Suggestions for control are to cage the tree trunks to prevent infestation, and the injection of carbon disulphide into the occupied burrows. The scientific name of the carpenter worm is *Prionoxystus robiniae*. This insect belongs to the order Lepidoptera.

FIGURE 63.—Carpenter worm.

Banded woolly bear.—In the fall and early spring there is a black and brown banded woolly bear caterpillar that appears to be wandering around aimlessly. Quite often it is noticed crossing highways or sidewalks. In the fall it attempts to find protected places where it can spend the winter. This caterpillar is the larva of the Isabella tiger moth. The moth, or adult insect, has a wing expanse of from 2 to 2½ inches. It is dull orange yellow with dusky spots. The adult has sucking mouth parts; the larva has chewing mouth parts and feeds on grass and leaves of various low-growing plants. Although it is of questionable importance, this insect can be controlled with stomach poisons. It belongs to the order Lepidoptera; the scientific name of the species shown here is *Isia isabella*.

FIGURE 64.—Banded woolly bear.

Bollworm or corn earworm.—Some insects have several common names, depending on the food plant on which they feed. This is one

reason why scientists assign a technical name to an insect. For instance, *Heliothis armigera* refers to the corn earworm or the cotton bollworm, known to tomato growers as the tomato fruitworm. No doubt many persons have seen this worm feeding on the end of a roasting ear or chewing holes in tomatoes; others have seen it feeding in cotton bolls, but probably few have realized that this worm is the young stage of a fawn-colored moth which has a wingspread of about 1½ inches. These moths have sucking mouth parts but cause no damage except in laying eggs that hatch into little larvae. The insects have complete changes in form during the life cycle, and there are several generations each year. They overwinter in the pupal stage in the earth. This pest is possibly public enemy No. 1 among the insects attacking the food crops of man. It is distributed through temperate and tropical regions and attacks various kinds of plants. Control measures will vary, depending on the crop.

FIGURE 65.—Bollworm.

Cutworms.—Practically everyone who has set out young plants has noticed that within a day or so after planting some are cut off just at the surface of the ground. Under such circumstances, a well-informed person usually scratches a little soil away from the remaining stump of the plant and there finds a gray worm or larva coiled and waiting for darkness so that it can attack another plant. These larvae are called cutworms. The parent is a night-flying moth. There are a great many different kinds of cutworms. The markings on the adults and larvae differ greatly. The moths have four wings, the hind pair usually being paler in color than the forewings. The wing expanse is about 1½ inches. Cutworms feed on many kinds of plants, and sometimes climb fruit trees and injure them. They have a complete life cycle and there is one generation a year. Eggs are usually laid in midsummer, and the insects overwinter as partially grown larvae. Cutworms are rather severe pests. The most common control measure is the application of poisoned bait; however, stomach poisons sprayed on the plants they are injuring will kill the climbing forms. The species shown here is the moth of the spotted cutworm (*Agrotis c-nigrum*).

FIGURE 66.—Cutworm.

Eastern tent caterpillar.—Practically every spring, about the time the apple and cherry trees, especially wild cherries, begin to leaf, there appears in the crotches of the branches a small web which harbors a young army of caterpillars. These little fellows appear as if by magic and start chewing the leaves off the trees. Sometimes they become abundant enough to strip all the leaves off these trees. This insect is called the eastern tent caterpillar (*Malacosoma americana*). Its parent is a moth that flies around at night early in the summer and deposits eggs on the branches of certain fruit trees. The eggs do not hatch until the following spring. The moths are reddish brown with whitish lines on

FIGURE 67.—Eastern tent caterpillar.

each forewing, as shown in the picture, and have a wing expanse of from 1 to 1½ inches. They have sucking mouth parts but do not feed. The caterpillars feed during the sunny part of the day. In commercial orchards, the usual poison sprays control these insects, but where they are found elsewhere they may be controlled by carefully burning or otherwise destroying the nests or webs as soon as discovery is made. Also spray small webs with one-eighth-percent DDT emulsion. Some relief may be had by destroying the eggs during the winter.

Grape leaf folder.—Around the grape arbor one often finds a very dark-brown moth with a wing expanse of nearly an inch. Two oval white spots appear on each forewing. The hind wings also have white markings. This insect is called the grape leaf folder (*Desmia funeralis*). The larva is an active pale-green caterpillar that rolls and ties the leaves of wild and cultivated grapes and chews the leaves within the tie. There are two or three generations each year, depending on the locality. The insect overwinters in the pupal stage. It is necessary to spray grape leaves with poison to control this pest.

FIGURE 68.—Grape leaf folder.

Codling moth.—How many times have you opened an apple and found a worm, half a worm, or a brown tunnel where the worm has been feeding? Even though many persons have seen the apple worm, few have seen the parent, which is called the codling moth. This moth is from about one-half to three-fourths of an inch in length. The four wings of the codling moth are folded leaflike over the back, and have numerous light-gray and brown markings. The moths lay their eggs on the leaves and fruit of several kinds of trees such as apple, pear, and quince. This insect has complete life changes, and there are from one to three generations a year, depending on the locality and climatic conditions. The full-grown larvae overwinter in silken cocoons hidden in crevices in the bark of trees or in similarly protected places. This insect is the chief pest of apples. Spraying is used in its control, although sanitary measures will help to reduce the number of overwintering larvae. Scientists speak of the codling moth as *Carpocapsa pomonella*.

FIGURE 69.—Codling moth.

Indian-meal moth.—Many housewives have become alarmed at the sight of a rather small moth, with ¾-inch wingspread, around the house, not realizing that this little creature originated in the pantry or the granary and is the Indian-meal moth, the larvae of which feed on all manner of dried vegetable products, seeds, nuts, fruits, etc. In the household it frequently is found in corn meal or oatmeal. This moth can be distinguished from the clothes moth by the wings, the outer or hind part being much darker in color than the fore part. The larva is a rather small white caterpillar, and almost all of the four life stages may be found any time of the year. This insect, which is called *Plodia interpunctella*, belongs to the order

FIGURE 70.—Indian-meal moth.

Lepidoptera. It can be controlled by cleaning out all the old corn meal in the cracks and crevices of the pantry, or by poison gas.

Clothes moths.—There are other small moths not quite so large as the one just described that are found most frequently around clothes closets where woolens and furs are stored. These insects are of a uniform fawn color, and the wingspread is only about one-half an inch. Each of the four wings is much narrower than those of most of the butterflies and moths. These insects are the clothes moths. Clothes moths have complete life changes. The young of the moths—the small white larvae—chew holes in woolen clothes and the mohair fabric on furniture. These moths do not feed on any vegetable products such as rayon or cotton. The larvae pupate where they have been feeding. There are three or more generations, and breeding is continuous throughout the year if buildings are heated. The best control is prevention by frequent airing, sunning of clothes, and storing in mothproof containers. Also use a residual spray on closet walls. The clothes moth shown here is the kind known as the webbing clothes moth (*Tineola bisselliella*).

FIGURE 71.—Clothes moths.

Webworms.—During the summer and fall there appear in the grasses a number of small moths that fold their wings closely about their bodies when at rest. They usually rest with their bodies forming an angle with the stalk of grass on which they alight, the front part of their bodies being farthest from the stalk. The palpi (mouth parts) are much elongated and extend beyond the head. The moths of this group belong to the genus *Crambus*. Owing to their peculiar resting position and extension of the palpi, they are readily distinguished from other small moths. The larvae of the *Crambus* are called sod webworms because they usually feed in a web on the roots of grass plants, where they overwinter. The wings of these moths are buff to light brown in color with a spread of from ¾ inch to 1¼ inches. The life changes are complete. The insects often cause considerable damage to corn and other members of the grass family. Insecticides and cultural practices are suggested for control. The species shown here is commonly called the larger sod webworm; the specific or scientific name is *Crambus trisectus*.

FIGURE 72.—Webworm moth.

Clearwing moths.—Any boy or girl who has found an insect like the one illustrated here perhaps has had a hard time deciding whether it belonged to the order including the butterflies and moths (order Lepidoptera), or to some other group of insects having clear wings. These moths do not have scales covering the entire wings, as do most of the others, but careful exam-

FIGURE 73.—Clearwing moth.

ination will show that scales are present on the body and at least on the veins and margins of the wings. Insects of this group also have a pronounced tuft of hair on the tip of the abdomen. They are known as the clearwing moths. The larvae, or caterpillars, of most of these moths chew their way into the woody portion of plants and often cause serious damage. These moths have complete life changes, and usually there is one generation each year. The moth shown here is the parent of the peach-tree borer (*Sanninoidea exitiosa*). It has a wingspread of 1¼ inches.

Skippers.—Among the butterflies and moths may be found insects that resemble butterflies when flying around in the daytime, but on close inspection they resemble moths because of their heavier bodies. If the antennae are hooked, as shown in the accompanying picture, these insects belong to the group called skippers. They get this name from their rapid, darting flight. The one pictured here is the locust skipper (*Epargyreus tityrus*). It has a wing expanse of from 1¾ to 2 inches. The forewings are dark brown with yellow bands and silver spots beneath; the hind wings are uniform in color. The mouth parts of these moths are made for sucking, and the larvae feed on various leguminous plants such as clovers. The skippers overwinter as pupae on the ground in dead leaves. The life changes are complete. These insects occasionally become pests. Stomach poisons will kill the larvae.

FIGURE 74.—Skipper.

DIPTERA (FLIES)

In this big insect world there is one group that is particularly annoying to picnic parties, either while they are attempting to eat or when they are fishing along streams. The group of insects referred to belongs to the order Diptera, which means that members of this family have two wings and only stubs where the hind wings ought to be. Members of this order vary considerably in size and shape, as the description of the following kinds, representing different families, will indicate.

Houseflies.—Possibly the most common of this group is the housefly (*Musca domestica*), which is about one-fourth of an inch long, gray with black stripes, eyes dark red, and abdomen yellowish at the base. Contrary to the ideas of many persons, the housefly cannot bite, as it has specialized or lapping-type mouth parts. The stablefly, which closely resembles the housefly and is quite often mistaken for it, has piercing mouth parts and can most certainly register its presence. Houseflies feed on all sorts of filth and possibly are one of man's worst enemies, since they carry disease organisms. They have complete life changes, overwinter in all stages, and have several generations each season. Space sprays and aerosol bombs [2] give temporary relief from flies. DDT residual sprays around

FIGURE 75.—Housefly.

[2] For more on the use of space sprays and aerosol bombs, see page 57.

barns, outbuildings, and houses provide effective and lasting fly control. Good sanitation is an important supplement to DDT sprays. Destroy breeding places and dispose of manure properly.

Syrphid flies.—Another family of flies that are quite often found hovering around flowers, or places where there is an abundance of plant lice, is the syrphid flies, of which there are a great many kinds. Although there is a wide variation in these insects, many have decided markings on the abdomen. The adults of this group have two wings and sucking mouth parts. These flies have complete life changes. Some larvae feed on aphids. One would need to examine but few colonies of plant lice before finding a very small, legless, sluglike creature feeding on the lice. This is the larvae of the syrphus fly. These flies remain over winter in the pupal stage among leaves on the ground or on stems of plants. Since they are beneficial, no control measures are necessary. The syrphus fly shown here is *Syrphus ribesii*, which varies from three-eighths to one-half inch in length.

FIGURE 76.—Syrphus fly.

FIGURE 77.—Flesh fly.

Blowflies.—During the summertime any meat or dead animal will draw a number of blowflies. The adults feed upon carrion and flowers, and the maggots of most species feed mainly on decaying meats. They overwinter in puparia in the soil.

In general, blowflies are considered beneficial because the maggots destroy dead animal matter. If they become so abundant that they are a nuisance, the maggots may be controlled by burying or burning the material in which they breed. Adult flies may be destroyed by sprays.

Flesh flies are blowflies, but differ from the others in that the female gives birth to living maggots. Other blowflies deposit eggs. The flesh flies are rather large and grayish in color with black stripes on their backs. Their abdomens are covered with hairs. The flesh fly here shown is *Sarcophaga plinthopyga*.

Green-bottle and blue-bottle flies are blowflies also. The bodies of these flies are metallic green or blue in color and shiny. These flies are larger than houseflies.

FIGURE 78.—Green-bottle fly.

Larvae of one species of blowfly are called screwworms. They infest wounds on animals and, by feeding on living tissue, cause suffering and great loss of livestock, mostly in the Southern States. Smear 62 (see item 131, p. 56) should be used to treat infested wounds and to protect against further blowing by the flies.

The green-bottle fly pictured here is *Phaenicia sericata*. This species of fly is from one-fourth to three-fourths of an inch long.

Horseflies.—In the horse-and-buggy days many runaways were caused by large black flies lighting on the horse. The group of flies to which this species belongs are called horseflies. They vary considerably in size and can be distinguished by the peculiar shape of the head, which is nearly all eyes and fits over the front part of the body cap fashion. The adults have two wings and piercing mouth parts. They feed on a number of animals. Horseflies have complete life changes and spend the winter as larvae in mud. Although these insects are pests, there is no effective control except drainage of the marshy areas in which many kinds breed. The black horsefly pictured here is *Tabanus atratus*. This species is from ¾ to 1⅛ inches long.

FIGURE 79.—Horsefly.

Robber flies.—Can it be possible that when man desired more speed in the air he looked to the robber flies? Most robber flies are rather large. Even though they have but two wings they are capable of flying very fast. They feed almost entirely on other insects. The head of the robber fly somewhat resembles that of the horsefly, but its neck is much longer. The adult has piercing mouth parts. These insects usually winter as larvae or pupae in the ground, where the larvae feed on worms and larvae of other insects. Like all other Diptera, the robber fly has complete life changes. The one shown here is *Promachus rufipes*, which attains a length of from 1 to 1⅜ inches.

FIGURE 80.—Robber fly.

Mosquitoes.—What person has not heard the buzzing of a mosquito or felt the mouth parts pierce an exposed part of the body? This group of Diptera possibly causes as much annoyance to people, especially picnickers, as any other insect. It is only the female mosquito that can bite, and not all kinds of mosquitoes feed on man or animals. In addition to causing annoyance from feeding, some mosquitoes are responsible for carrying diseases such as malaria and yellow fever. Malaria is a major health problem in the South. All mosquitoes have a long, narrow body with comparatively long legs and two wings. The life changes are complete. The larvae, or "wigglers," are found in stagnant water. Mosquitoes breed commonly in rain barrels, cisterns, ponds, and other places where water stands. Drain stagnant pools if possible. Cover water containers tightly. Treat breeding areas with DDT. Use residual DDT sprays to control adults. Use repellents to prevent bites. Mosquitoes are usually much smaller than crane flies, and can be distinguished from crane flies by the tiny hairs on the margins of the wings. The one shown here is the yellow-fever mosquito (*Aedes aegypti*), which is about three-sixteenths of an inch long.

FIGURE 81.—Mosquito.

Crane flies.—Quite often one sees long-legged, awkward insects which look like overgrown mosquitoes flying over the fields. They are commonly called crane flies. These flies vary from one-eighth of an inch to 2 inches in length and are brownish in color with mottled wings. The adults have lapping mouth parts and probably lap nectar from open blossoms. These insects have complete life changes and spend the winter as eggs, or larvae, in the soil. The larvae are sometimes called leatherjackets because of their leathery skin. Occasionally they warrant a control measure. Poisoned bait is effective. The male of the range crane fly pictured here, *Tipula simplex*, has wings but the female is wingless. This species is from three-eighths to one-half of an inch in length.

FIGURE 82.—Crane fly.

HYMENOPTERA (WASPS AND OTHERS)

There is another group of insects that in many respects resemble flies, partly because of their clear wings. This group is the Hymenoptera. They may be distinguished from the flies by the number of wings. The winged Hymenoptera have four wings, but they are often so close together that it is difficult to tell whether there are two or four unless they are examined at the point of attachment to the body. Insects in the group vary considerably in appearance. Among them are the wasps, ants, bees, etc. For the most part, a basal portion of the abdomen is reduced to a very slender, threadlike structure, which varies in length, depending on the species.

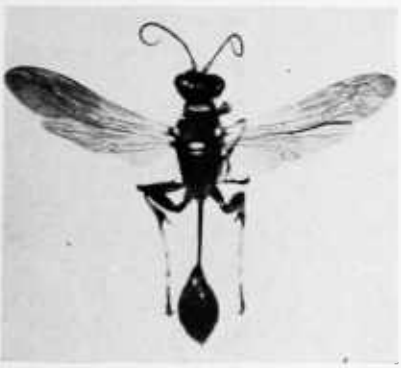


FIGURE 83.—Wasp.

Wasps.—In the wasp, this slender structure is very long. The mud-dauber wasp (*Sceliphron caementarium*) shown here is almost an inch long, black with orange-yellow markings. It has modified mouth parts for chewing and lapping. The adult feeds on flowers, and the larva feeds on paralyzed spiders which the parent wasps store in cells. The wasp has complete life changes and overwinters as a full-grown larva in the cell of the mud nest. The economic importance of this insect is questionable.

FIGURE 84.—Golden digger wasp.

Golden digger wasp.—Another insect of the order Hymenoptera, closely related to the mud-dauber wasp, is the golden digger wasp. It also is about an inch long, black or

reddish yellow with golden hair, and has four wings. This insect has complete life changes. The mouth parts are fitted for chewing and lapping. This wasp, *Ammobia ichneumonea*, in the adult form feeds on flowers, and the larva feeds on paralyzed grasshoppers. It hibernates in a cell in the ground, probably as a full-grown larva or pupa. Because it destroys grasshoppers it can be considered beneficial.

Bald-faced hornet.—Another of the wasps, and one having a short, thick body, is the bald-faced hornet. The queen of this species is about seven-eighths of an inch long; the workers are somewhat smaller. This wasp is black with creamy-white markings and has four wings which enable it to fly rapidly. The mouth parts are fitted for chewing and lapping. The bald-faced hornet also is able to inflict a painful sting. The adult feeds on flowers, fruit juices, and honeydew; the larva feeds on softened insects. This insect has complete life changes; the adult queens hibernate in sheltered places such as under bark or in crevices. When the days begin to warm in the spring, the queen starts the construction of her paperlike nest, and as soon as sufficient comb is built, begins to rear her brood. As the season advances and the first workers emerge, the nest is increased in size by tearing out the inner lining, widening the layers of comb, and adding more layers of comb below. Additional layers of the paperlike covering of the nest are then built on the outside. This material consists of wood fibers mixed with a salivary secretion, is waterproof and very tough, and affords protection for the nest. The nest sometimes attains the size of a foot or more in diameter. The economic importance of this insect is questionable, although it does kill some destructive insects. The bald-faced hornet shown here is *Vespula maculata*, and belongs to the order Hymenoptera.

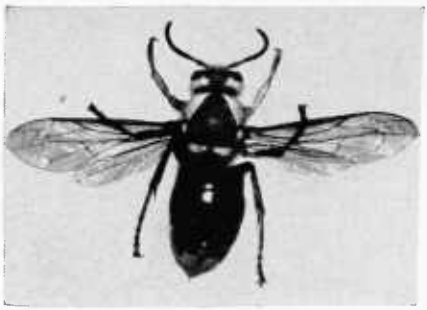


FIGURE 85.—Bald-faced hornet.

Parasitic wasps.—No doubt many persons have encountered wasplike insects with long appendages like the one shown here, but have not realized that these threadlike structures are for egg laying. The insect illustrated here, *Megarhyssa macrurus*, is an inch or more long. The egg-laying structure, or ovipositor, may be 3 inches long. The body is very slender, light brown, with lighter chevrons along the sides of the abdomen. Although the adult has chewing mouth parts, it is doubtful if it does very much feeding, but the larva feeds by sucking the blood from the larva of the pigeon horntail. The long egg-laying appendages permit this wasp to drill

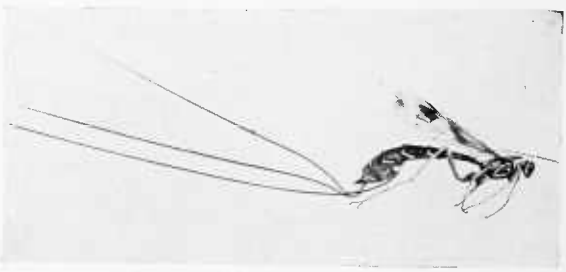


FIGURE 86.—Parasitic wasp.

rather deeply into the wood to parasitize the larva of the pigeon horntail. There are many more insects in this group, but they have much shorter egg-laying appendages. This insect has complete life changes, as do all other Hymenoptera.

FIGURE 87.—Parasitic wasp.

Parasitic wasps.—Another of the group Hymenoptera or wasplike insects is *Coccygomimus pedalis*. It is a parasite of other insects and therefore may be considered beneficial. This insect is about one-half inch long, black, with four clear wings. The legs are brownish red except for the hind tibiae and tarsi, which are black. The tibiae and tarsi are the parts of the legs farthest removed from the body. The mouth parts are fitted for chewing. This insect overwinters as a larva in the pupa of the moths, upon which the larva feeds. As with all other wasps, the life changes are complete.

Ants.—Many interesting hours have been spent by people in watching and studying the activities of the ants, and many books have been written about them. Ants are social insects and live in colonies as do the bees, which belong also to the order Hymenoptera. They vary considerably in size, but all have three distinct body regions. They are wingless except at swarming time. The swarming forms have four clear wings which they lose soon after they establish their new quarters. Ants have chewing mouth parts. They have complete life changes. The particular species shown here is the black carpenter ant (*Camponotus herculeanus pennsylvanicus*). It is about three-eighths of an inch long. It builds its nest in decaying wood of various kinds, and sometimes in sound wood. The adults hibernate in the nest. This ant is sometimes injurious to timbers in buildings. Ants cause annoyance by their presence and by getting into food. Use chlordane insecticides or poison baits where these insects are found. Locate nests and treat them with chlordane or a fumigant.

FIGURE 88.—Ant.

Honeybees.—It is doubtful that man has probed into the private life of any other insect as much as he has into the life of the honeybee. Perhaps one reason for this is that the honeybee has been known for centuries and has been the only insect to provide a natural sweet. Beeswax has been used for a long time in the preparation of various household articles. In more recent years honeybees have been found to be important factors in the pollination of blossoms, which is essential to seed and fruit production. Honeybees are social insects and live in colonies. There are several races. The workers are about five-eighths of an inch long and usually dark brown in color. Like other Hymenoptera, they have four wings, and the adults fly readily. The mouth parts of the adults are modified for sucking

FIGURE 89.—Honeybee.

liquid foods such as the nectar of flowers. The honeybee (*Apis mellifera*) spends the winter in the adult stage in the hive. The life changes are complete.

Bumblebees.—What farm or small-town boy or girl has not had the experience of fighting a nest of bumblebees? It is doubtful if any of these boys or girls realized that bumblebees are beneficial insects and necessary to the pollination of certain flowers, especially the clovers. Bumblebees are so well known that little description is necessary. However, it should be stated that they are about five-eighths of an inch long, have four wings, belong to the order Hymenoptera, and have mouth parts modified for chewing and sucking. The adults feed on flowers. It is at the time of feeding as well as of gathering nectar and pollen, upon which they rear their young, that they pollinate the flowers. Bumblebees have complete life changes and overwinter as adult queens in sheltered crevices or cavities. The one shown here, *Bombus americanorum*, is sometimes called the black-tailed, yellow-banded bumblebee.

FIGURE 90.—Bumblebee.

Pigeon tremex.—The pigeon horntail (*Tremex columba*) is one of our largest Hymenoptera. It may grow to be 1½ inches in length, exclusive of its egg-laying appendages. It is black, with ocher-yellow markings, the proportionate amounts of yellow varying. The mouth parts are modified for chewing and lapping. The larva of this insect bores into the dying branches or trunks of trees such as maple, elm, apple, pear, beech, oak, and sycamore, and apparently spends the winter as a full-grown larva or pupa in the trunks of these trees. This insect, like all other Hymenoptera, has complete life changes. Infestations may be prevented by keeping trees in a vigorous growing condition. In case of heavy infestation, trees may be cut and burned during the fall and winter, thereby destroying the larva.

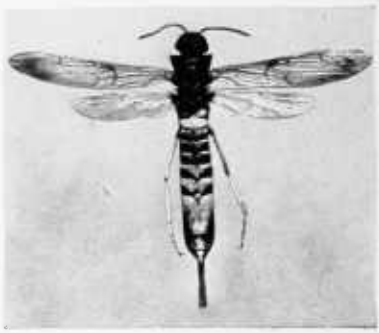


FIGURE 91.—Pigeon tremex.

FIGURE 92.—Chalcid fly.

Chalcid flies.—If it were not for our friends in the insect world, certain pests would make our existence difficult. Some of these friends of ours are very tiny and frequently unnoticed; for example, the chalcid flies. Some species are parasitic and live inside various other insects. All chalcid flies belong to the order Hymenoptera. They have four wings, chewing mouth parts, and complete life changes. The species

shown here is *Brachymeria ovata*, which lives as a parasite inside the pupae of various moths. It is about three-sixteenths of an inch long. It overwinters possibly as an adult, or perhaps within its host as a full-grown larva. Some species of chalcids, however, live in seeds. These may be controlled by cultural practices.

Sawflies.—In the order Hymenoptera is another group of insects, the sawflies, whose larvae very much resemble caterpillars. Adult sawflies rest with their wings folded flatwise over their backs. The adult shown here is about three-eighths of an inch long. The wings have been spread to show the structure. This is the imported currant worm (*Pteronidea ribesii*). The larva chews holes in the leaves of currants and gooseberries. It has complete life changes and overwinters as either a full-grown larva or a pupa in a silken case in trash on the ground near where the larva feeds. It can be controlled with any good stomach poison.

FIGURE 93.—Sawfly.

MISCELLANEOUS GROUPS

FIGURE 94.—Lacewing.

Lacewings.—Very few clusters of aphids or plant lice appear without the presence of small cream-colored lizardlike insects. These active little insects, which are the larvae of lacewing flies, have long, sickle-shaped jaws in addition to antennae, or feelers. The parent as pictured here is pale green in color; some species have black and red markings about the head. This insect is approximately half an inch long. It has chewing mouth parts, four lacelike wings, and can either crawl or fly. The larvae have a combination of chewing and sucking mouth parts; that is, the sickle-like projections referred to earlier are hollow, and after the larvae have pierced the bodies of weaker insects they suck the body fluids of their prey through the hollow, hooked mouth parts. Lacewing flies have a complete metamorphosis. They belong to the order Neuroptera. The full-grown larvae or adults overwinter under bark, in fallen leaves, etc. These insects are beneficial in helping to control pests. The species shown here is *Chrysopa oculata*.

FIGURE 95.—Dragonfly.

Dragonflies.—Every boy or girl who has wandered along a stream has seen the insect which in some sections is called a snake feeder, or snake doctor, but as a matter of fact it is a dragonfly and has no connection with snakes. The adults have four thin glossy wings, some with smaller or larger darker patches and numerous veins. The adults have chewing mouth parts and catch insects while in flight. The nymphs are carnivorous and live in water, where they feed on insects and other small aquatic animals. Dragonflies

winter as nymphs in water, particularly in ponds and lakes, and may be considered of some value as enemies of flies and mosquitoes and as fish food. The life changes are incomplete. The species shown here is the 10-spotted dragonfly (*Libellula pulchella*). Its body is about 2 inches long and its wing expanse about 3½ inches. This insect belongs to the order Odonata.

Damsel flies.—There is another group of the Odonata called damsel flies. They have long, narrow bodies with shiny wings that taper rather sharply to the point where they are attached to the body. When at rest these wings are folded rather close to the body. These insects have chewing mouth parts, and the adults catch small insects from the air during flight. The nymphs feed on small insects and other aquatic animals, and winter usually in small streams. The life changes of the damsel fly are incomplete. These insects are of some importance, as are the dragonflies, and for the same reasons. The species shown here is the black-winged damsel fly (*Agrion maculatum*). It has a body about 1¾ inches long and a wing expanse of 2½ inches. In this species the wings are shiny black and the body metallic green with black on the thorax.

FIGURE 96.—Damsel fly.

Termites.—In recent years we have been hearing more and more about a little insect pest that has caused destruction to frame buildings. Many people call this insect the white ant. It is really not an ant but a termite, which belongs to the order Isoptera. Termites differ from ants in that the body is of fairly uniform width throughout its entire length, whereas the body of the ant appears pinched in the middle to almost a thread. Termite wings are about twice as long as the body, whereas the wings of the ant are about as long as the body. The members of this family are social and live in colonies as honeybees do. Each species has a number of different forms or castes within the colony. Most people make the acquaintance of termites during swarming season, at which time they come out in great droves from around the floor or foundation of an infested house. Termites during the swarming season have four rather large wings, loosely attached to the body. The workers of this group of insects are the ones that cause damage by chewing the wooden parts of houses, but they also work on a great many plant or animal products. Most species of termites work under cover and must have contact with soil moisture. In nature, termites can be found feeding almost any place where there is dead wood on or in the ground. The species shown here is *Reticulitermes flavipes*, and this worker is about one-fourth of an inch long. Control measures vary according to conditions.

FIGURE 97.—Termite.

Earwigs.—Collectors often come across insects with hooklike appendages on the hind portion of the body. These, no doubt, are earwigs, which belong to the order Dermaptera. They have chewing

mouth parts and feed primarily on plant material, but also may eat organic substances including meats or dead or weakened insects. The true wings are folded in a complicated manner beneath the wing covers or nonfunctional front wings. These insects dig in the soil, hide under old boards and other suitable shelter, and may remain over the winter either in the egg stage or as adult earwigs. The life changes are incomplete. Earwigs are sometimes pests and should be controlled by poisoned baits and sanitation. The accompanying picture is that of the male European earwig (*Forficula auricularia*), now to be found in the United States. Adult insects of this species are from one-half to three-fourths of an inch long.

FIGURE 98.—Earwig.

Fleas.—Whenever cats and dogs are kept around the house, there is likelihood of introducing small insects that cause much annoyance to members of the household by attacking their legs and sucking the blood. Certain species carry bubonic plague. These insects are fleas, of which there are many kinds, but all types belong to the order Siphonaptera. They usually are dark reddish brown, very much flattened, and give the appearance of standing on edge. Fleas do not have wings. They have sucking mouth parts; the legs are fitted for jumping and are their only means of locomotion. The changes in the life cycle are complete. The larvae usually are found wherever cats, dogs, hogs, and some other animals bed down. The human flea (*Pulex irritans*) is shown here. It is about one-eighth of an inch long. Treating cats and dogs with derris powder, cleaning up the bedding of these animals, and spraying or dusting the premises with insecticides will help to control this pest.

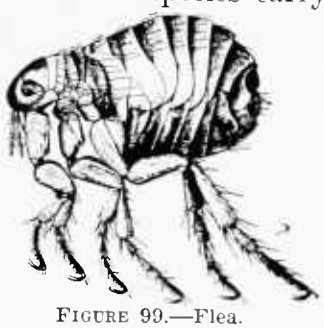


FIGURE 99.—Flea.

Silverfish, silver moth, or bristletail.—There is another small silvery-colored insect usually found on the floor, around books, or in other dark places. Occasionally it ventures out into the light. It has several common names such as silverfish, silver moth, or bristletail. It is wingless, and the body tapers rather gradually to the hind end, which branches out into three very definite spikes. These spikes give it the name bristletail. The silverfish belongs to the order Thysanura. Since the adult has the same form as the larva, it cannot be considered as having a metamorphosis; that is, there are no changes in form during the life cycle. It has chewing mouth parts and feeds especially on starchy materials such as bookbindings, wallpaper, and starched clothing. In the house this insect is active throughout the year and has no definite hibernation period. The species shown here is from one-half to five-eighths of an inch long and is *Lepisma saccharina*. Use of poisoned bait made of a mixture

FIGURE 100.—Silverfish.

of oatmeal, white arsenic, sugar, salt, and water is one method of control. DDT or chlordane sprays or dust are preferred for treatment.

Caddisflies.—Along streams where the water flows rather swiftly, one finds small mothlike insects of pale-brown color with wings folded rooflike over their backs. These are the caddisflies. Unlike those of the moths, the two pairs of wings are scaleless and usually more or less clothed with long, silky hairs. The adults take very little food, but many accept sweet fluids to a certain extent. They fly readily. The larvae crawl or swim in water and feed on water forms of either plant or animal life. They winter as larvae, usually in streams. Their life changes are complete. The caddisfly shown here is about three-fourths of an inch long with a wing expanse of about 1½ inches. A sketch of the caddisfly, appearing in the section on collections and identification, order Trichoptera, part III of this manual, gives an idea of the position of the wings when at rest. The scientific name of this insect is *Pycnopsyche subfasciatus*.

FIGURE 101.—Caddisfly.

Stone flies.—There is another group of insects that live around rapid streams and wave-washed, rocky shores. This is the stone fly group, which belongs to the order Plecoptera. These insects range from ¾ to 1½ inches in length, are pale brown, and the wings are folded flat over the back. They have chewing mouth parts, but the adults feed very little; the nymphs feed mainly on insects in the fast-flowing streams. The adults fly readily, but the nymphs crawl and swim in the water. The stone fly winters as a nymph in water leading to large rivers. The life changes are incomplete. The nymphs may serve as fish food. The species shown here is *Acroneuria abnormis*.

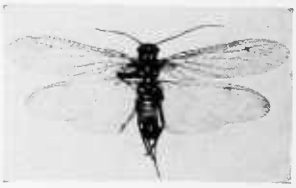


FIGURE 102.—Stone fly.

INSECT RECORD SHEET

I. Common name of insect_____

II. Description:

1. Size (indicate by mark)_____
2. Color_____
3. Mouth parts: Chewing_____; sucking_____; lapping_____
4. Number of wings_____

III. Where does insect live: Air_____; soil_____; water_____; in host_____

IV. On what does insect feed:

Item	Leaves	Blossoms	Fruits	Branches	Main stems	Roots
Flowers						
Shrubs						
Orchard trees						
Other trees						
Hay crops						
Grains						
Vegetable crops						
Other crops						

Wood_____; wood products_____; woolens_____; furs_____
Fabrics_____; food materials_____; stored products_____
Man_____; animals_____; other insects_____
Tiny plants or animals in water_____

V. Habits:

1. How does it spend the winter:
   Egg_____; larva_____; nymph_____; pupa_____; adult_____
2. Where does it spend the winter?
   _____
3. Kind of life cycle:
   a. Complete (four stages)_____
   b. Incomplete (less than four)_____

VI. Economic importance:

1. Pest_____
2. Beneficial_____
3. Questionable_____

VII. Control for pest:

1. Stomach poison_____
2. Contact spray_____
3. Sanitation_____
4. Cultural practices_____

Part II.—LIFE STUDIES AND CONTROL OF INSECTS

(Introduction to second-year work)

LIFE STUDIES

(How insects grow)

Once the insect becomes an adult it never grows any larger. A gnat will always be a gnat: it is not a baby fly. Insects make all their growth while in the immature stages. There are, however, two types of growth. Some insects, like the grasshopper, develop gradually,

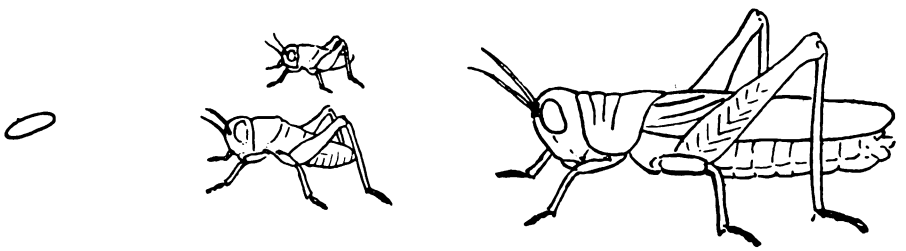


FIGURE 103.—Incomplete metamorphosis.

and each time they shed their skin, the newly emerged young more closely resemble the adults. We call this incomplete metamorphosis. Grasshoppers, crickets, the true bugs, and plant lice go through incomplete metamorphosis.

The young or larvae of the butterflies and beetles do not resemble the adult. When the larva has completed its growth, it goes into a

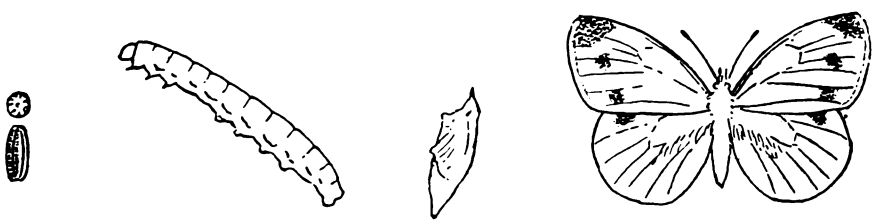


FIGURE 104.—Complete metamorphosis.

pupal stage where the complete change, which we call complete metamorphosis, takes place. Butterflies, beetles, wasps, and flies go through complete metamorphosis.

CONTROL OF INSECTS

Many years ago very little was done about insect control, as outbreaks that caused serious damage occurred only occasionally. Since then many changes have taken place, and we have an entirely different problem today.

Through commerce, man has upset Nature's balance, and many insects have been accidentally introduced and their natural enemies have been left behind. Many plants have been introduced which provide better food for native insects than native plants provide, thus stimulating the rapid reproduction of these favored insects. Certain plant breeding has made plants more susceptible to insect attack. Then, also, one phase of our agricultural system—the planting of large acreages of one kind of crop in a concentrated area—has made it possible for insect pests to increase in such destructive numbers that they can cause serious damage.

In recent years quarantines have been put into effect which regulate the shipment of plants and animals. Plant breeders are working toward greater resistance in plants to insects and diseases. Much work with parasites is being done to help Nature reestablish her balance. All these factors are helping, but more immediate or drastic control measures are necessary, and chemicals poisonous to insects must be used in many cases.

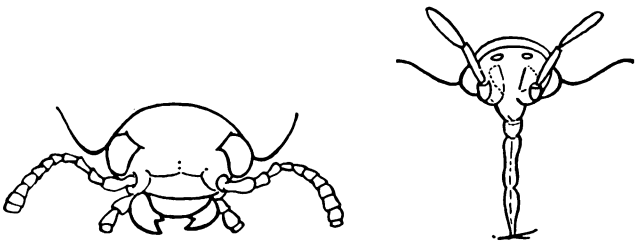


FIGURE 105.—Chewing mouth parts (left); sucking mouth parts (right).

In the earlier days, a blanket recommendation was made—stomach poisons for chewing insects and contact sprays for sucking insects. Now an effort is being made to use less and less of the metallic poisons. The organic or plant-product sprays have been found to be much more specific, and the old rule does not always apply. A person must know much more about insects and insecticides (spray material) than was formerly necessary if he hopes to control insects adequately.

This control phase of the project is for the purpose of acquainting the club member with insect habits and the effect of different control measures.

COLLECTION AND IDENTIFICATION

In addition to studying insect control and life habits, club members of second-year groups should endeavor to collect and prepare notes on eight orders of insects not included in the first-year work. Some of the orders listed below contain many small insects, specimens of which should be mounted on small cardboard points or preserved in alcohol or formaldehyde.

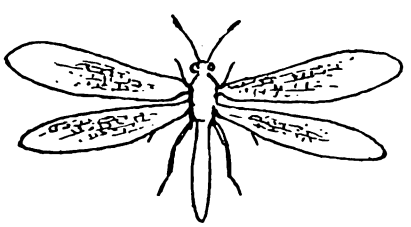


FIGURE 106.—Lacewing.

NEUROPTERA.—Neuron (nerve), pteron (a wing). Four large leaflike wings, nearly equal in size, usually finely netted; wings notched, held rooflike over back when at rest. Antennae long. Mouth parts for chewing. Life changes (metamorphosis) complete. Larvae of some living in the water. Dobson flies, aphis lions, ant lions (doodlebugs).

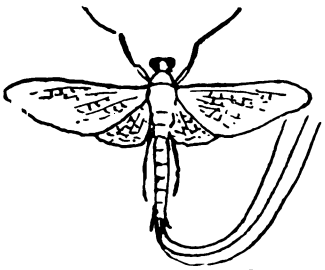


FIGURE 107.—Mayfly.

EPHEMERIDA.—Ephemeron (a short-lived insect). Four netted, veined wings folded vertically over back when at rest; hind pair much smaller than front pair. Mouth parts for chewing. Antennae short. Three long tails on tip of abdomen. Life changes incomplete. Body rather frail; molt once in adult stage. Very short lived. Nymphs living in the water. Mayflies, lake flies, or shad flies.

FIGURE 108.—Termite.

ISOPTERA.—Isos (equal), pteron (a wing). Most forms wingless; kings and queens having four wings at mating time; wings equal in size, long, narrow, and folded over back when at rest. Somewhat resembling ants, but pale in color and having no slender waist in abdomen. Termites (white ants).

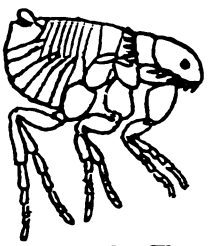


FIGURE 109.—Flea.

SIPHONAPTERA.—Siphon (a tube), apteros (without wings). Small, wingless body, laterally compressed (flattened at sides). Hind legs long, stout, fitted for jumping. Mouth parts piercing and sucking. Life changes complete. Fleas.

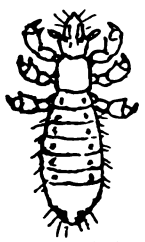


FIGURE 110.—Sucking louse.

ANOPLURA.—Anoplos (unarmed), oura (tail). Small, wingless, flattened parasites of mammals. Mouth parts for piercing and sucking. Head narrow and pointed in front. Eyes wanting or degenerate. Life changes slight. Blood-sucking lice.

FIGURE 111.—Biting louse.

MALLOPHAGA.—Mallos (wool), phagein (to eat). Small, wingless, flattened insects. Large broad heads, rounded in front; eyes degenerate; mouth parts for chewing. Life changes incomplete. Mostly parasites of birds, some of mammals. Chewing lice or bird lice.

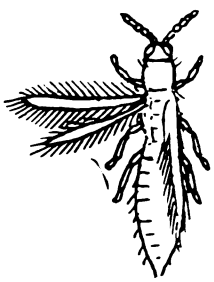


FIGURE 112.—Thrip.

THYSANOPTERA.—Thysanos (fringe), pteron (a wing). Mostly wingless; when wings are present, four long and narrow, fringed with hairs, folded over back when at rest. Body much elongated. Mouth parts for rasping. Life changes incomplete. Thrips.

FIGURE 113.—Silverfish.

THYSANURA.—Thysanos (a tassel), oura (tail). Small, gray, wingless insects. Long antennae. Mouth parts for chewing, and long bristlelike tails. No metamorphosis, that is, no changes in form during life cycle. Body somewhat carrot shaped. Found in dark places. Feeds on starchy substances such as bookbinding. Silverfish, bristletails, or fish moths.

CALENDAR OF ACTIVITIES, SECOND YEAR

Meetings	Life studies and control of insects	Page
First, February	Organization. Repair collecting equipment	46
Second, March	Outline work. Study bulletins. Make collection boxes	46
Third, April	Spring survey. Make preservatives for immature insects	46
Fourth, May	Select insects to be reared. Make rearing cages	47
Fifth, June	Select control project. Mix and apply insecticides	47
Sixth, July	Visit control projects. Make mounts of insects and plants	48
Seventh, August	Check results of control. Exhibit control material	48
Eighth, September	Make hibernation cages. Collect and place insects in cages	49
Ninth, October	Exhibit insects. Stunts and plays about insects. "Wienie" roast	49
Tenth, November	Complete record books. Spade garden or follow plow	49
Eleventh, December	Identification contests. Judging contests	50
Twelfth, January	Make permanent exhibit for school or county agent's office	52

ACTIVITIES FOR SECOND YEAR OUTLINED

ORGANIZATION. REPAIR COLLECTING EQUIPMENT

[First meeting—February]

Equipment:

1. Copy of insect manual.
2. Material to repair old collecting equipment or make new.

Procedure:

1. Read and discuss each paragraph of manual separately.
2. Make net according to instructions on page 7, part I, of this manual.

OUTLINE WORK. STUDY BULLETINS. MAKE COLLECTION BOXES

[Second meeting—March]

Equipment:

Cigar box, corrugated cardboard, manual, bulletins.

Procedure:

President of club, club agent, or entomologist outlines work for year; reads manual. Before next meeting, each club member should make survey of insect pests about his home.

SPRING SURVEY. MAKE PRESERVATIVES FOR IMMATURE INSECTS

[Third meeting—April]

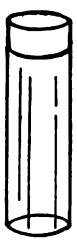


FIGURE 114.—Vial for preserving immature insects.

Equipment:

Small vials (size of man's largest finger) with stoppers; 5-percent solution of formaldehyde.

Procedure:

1. Dilute formaldehyde to 5-percent solution.
2. Distribute solution in vials, to members.
3. Field trip. Make survey of abundance of important insect pests in hibernation or on crops.

FIGURE 115.—Insect, preserved in vial.

SELECT INSECTS TO BE REARED. MAKE REARING CAGES

[Fourth meeting—May]

FIGURE 116.—Glass insect rearing cage.

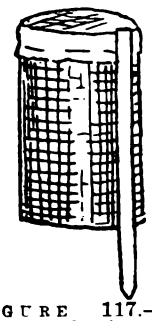


FIGURE 117.—Screened insect rearing cage.

Equipment:

1. Each member should have a list of common insects about the farm or home.
2. Glass container with both bottom and top open, such as lamp chimney or fruit can with bottom removed.
3. A piece of cheesecloth.
4. Flowerpot or can in which to grow plant.
5. Screen wire.
6. Sticks of wood (small, to support screen cage).
7. Carpet tacks.

Procedure:

1. From life cycle presented in books or bulletins, decide which insects can be reared during summer.
2. As far as possible, have each member select a different insect to rear.
3. Outline procedure for rearing insects.
4. Glass cage.
   - *a.* Place globe over plant and firm it in soil.
   - *b.* Fasten cheesecloth over top.
5. Screen cage.
   - *a.* Roll screen to make cylinder of desired size.
   - *b.* Tack stick to fold in screen (leaving stick 2 or 3 inches longer than screen).
   - *c.* Fasten cloth or screen over top.
   - *d.* Insert point of stick in soil. Firm soil around base of wire.

SELECT CONTROL PROJECT. MIX AND APPLY INSECTICIDES

[Fifth meeting—June]

Equipment:

1. List of crops or animals about your home.
2. List of insects causing damage.
3. Samples of all insecticides to be used by each club member.

FIGURE 118.—Insecticide containers.

4. Necessary vessels for mixing.
5. Bulletins and books on insect control.

Procedure:

1. Select most troublesome insect pests in community.
2. Assign to each club member a different insect to control.
3. Work out control measures to be followed by each club member.
4. Each member, or team, demonstrates mixing of each kind of insecticide to be used.
5. Tell story of need for thorough mixing, for caution, etc.

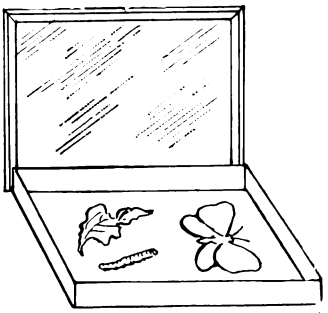


FIGURE 119.—How to mount specimens of insect and its injury to host.

VISIT CONTROL PROJECTS. MAKE MOUNTS OF INSECTS AND PLANTS

[Sixth meeting—July]

1. Piece of glass about 6 by 8 inches (windowpane).
2. Shallow box, 6 by 8 by 1 inches.
3. Cotton.
4. Insect and portions of damaged plants or products.
5. Paper for labels.
6. Tools: Hammer, saw, pincers, chisel, etc.
7. Record sheets for insect-control experiment.

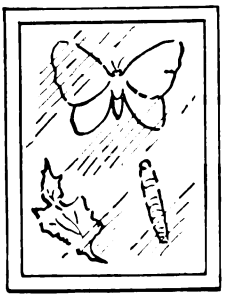


FIGURE 120.—Mount, complete, showing insect and injured host.

Procedure:

1. Visit control project.
   - *a.* Compare sprayed and unsprayed plants.
   - *b.* Select life stages of the insect.
   - *c.* Select typical injury to leaves, fruits, or twigs.
2. Fit lid for box; use glass for top.
3. Place cotton in box.
4. Arrange insect and damaged leaves, cloth, etc., in box.
5. Fasten lid on box.
6. Fill out record sheet with information on spray for insect control.
7. Write narrative report. Sample copy of a narrative report appears on page 51.

CHECK RESULTS OF CONTROL. EXHIBIT CONTROL MATERIAL

[Seventh meeting—August]

Equipment:

1. Pencil and notebook.
2. Equipment to weigh or measure crop.
3. Insect mounts.

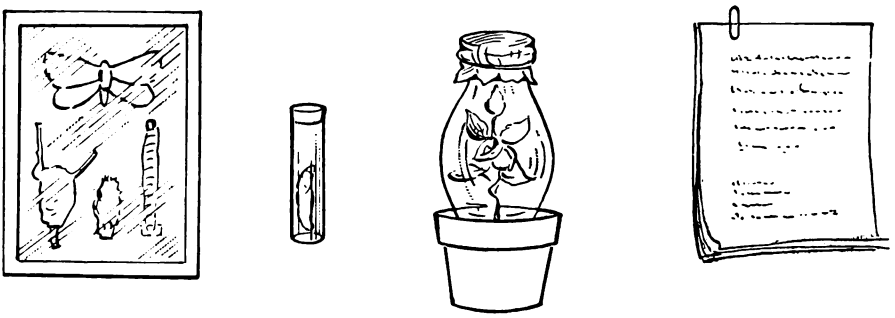


FIGURE 121.—Materials used in insect studies.

4. Preserved specimens of immature insects.
5. Potted plants showing insects and damage.

Procedure:

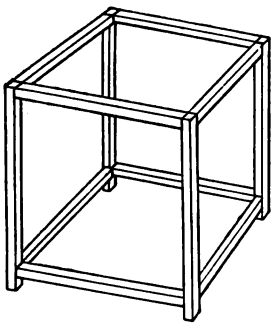
1. Harvest crop.
2. Weigh or measure crop.
3. Record weights or measures for check and control.
4. Arrange exhibit showing each club member's mounts, preserved insects, and potted plant; also any notes available.

MAKE HIBERNATION CAGES. COLLECT AND PLACE INSECTS IN CAGES

[Eighth meeting—September]

Equipment:

1. Two pieces of screen about 24 inches square and one piece 24 inches wide and 6 feet long (or enough to cover four sides of a 24-inch cube).



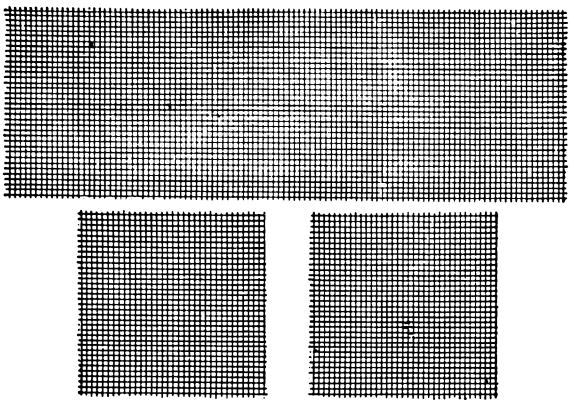


FIGURE 122.—Materials for making hibernation cage.

2. Wooden strips to make frame for cage (eight 1- by 1- by 20-inch, and four 1- by 1- by 22-inch strips).
3. Nails and carpet tacks.
4. A container in which to collect live insects.

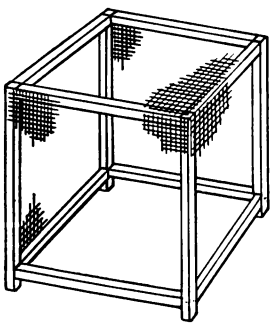


FIGURE 123.—Hibernation cage, complete.

Procedure:

1. Nail frame together.
2. Cover with screen.
3. Tack very tightly to prevent insects' escape.
4. If possible, fit door into one side.
5. Allow the four longer corner strips to extend below wire.
6. Sink longer legs in soil.
7. Place leaves, sticks, etc., in cage.
8. Collect live insects from crops.
9. Place several hundred beetles or bugs inside.
10. Examine occasionally to see that cage has not been molested.
11. Examine and count bugs that come out alive in spring.

EXHIBIT INSECTS. STUNTS AND PLAYS ABOUT INSECTS. "WIENIE" ROAST

[Ninth meeting—October]

Equipment:

1. Collections of insects.
2. "Wienies," marshmallows, cider, etc.
3. Club members, parents, and friends.

Procedure:

1. Arrange collections.
2. Prepare and serve refreshments.
3. Games, stunts, and plays.

COMPLETE RECORD BOOKS. SPADE GARDEN OR FOLLOW PLOW

[Tenth meeting—November]

Equipment:

1. Record book, pencils.
2. All notes taken during year.
3. Spade.
4. Blank forms.

Procedure:

1. Completely fill out record books.
2. Fill out blank forms from information on pages 54 to 56.
3. Spade garden or follow plow.
   a. See how many insects are in trash to be plowed under.
   b. See how many soil insects can be found on freshly turned soil that are exposed to the weather and birds.
4. Plant cover crops on freshly worked soil.

Name_____
(Club member)

Insect-Control Experiment

Spray Record Sheet

Name of plant: Cabbage

Name of insect to be controlled: Cabbage worm

Does this insect have chewing or sucking mouth parts? Chewing

What spray or dust material was used? Derris

Strength of dust material: 0.75 - percent rotenone

Spray Calendar

Application	Date	Height of plant	State of development of plant
		Inches	
First	May 15	8	Well leafed out.
Second	May 25	10	Heads beginning to form
Third	June 10	12	Heads well formed.

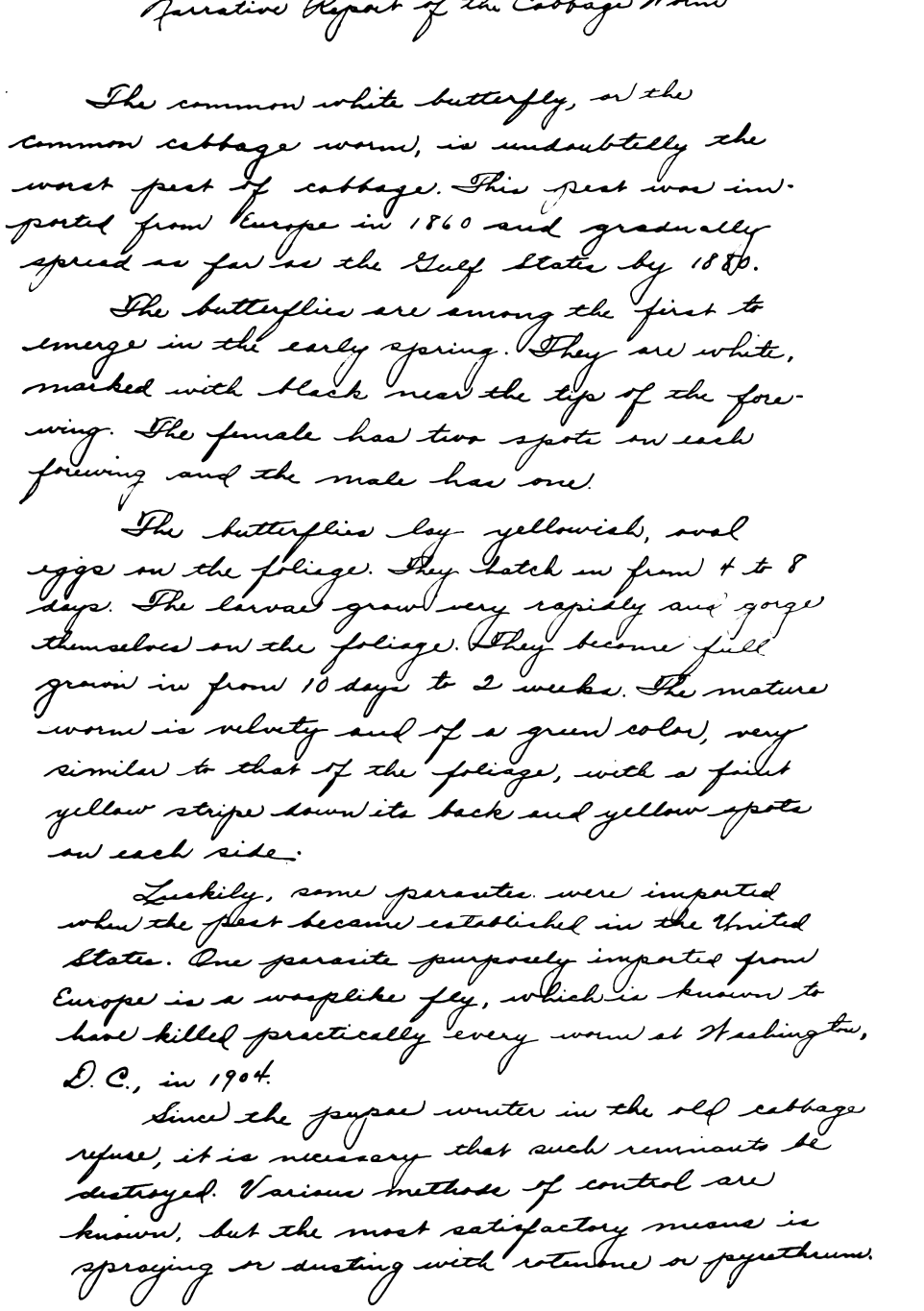
FIGURE 124.—Sample of record sheet.

IDENTIFICATION CONTESTS. JUDGING CONTESTS

[Eleventh meeting—December]

Contests may be used to make individuals better acquainted with insects and insect injury to the host, as well as with control measures. Contests may be between individuals within a club or between members of different clubs. Each club member may fill out a form for 10 insects as indicated in the contest record sheet shown on page 52.

Equipment (identification):
1. Representative specimens of several insects, each bearing a number.
2. Record sheets.



Narrative Report of the Cabbage Worm

The common white butterfly, or the common cabbage worm, is undoubtedly the worst pest of cabbage. This pest was imported from Europe in 1860 and gradually spread as far as the Gulf States by 1880.

The butterflies are among the first to emerge in the early spring. They are white, marked with black near the tips of the fore-wing. The female has two spots on each forewing and the male has one.

The butterflies lay yellowish, oval eggs on the foliage. They hatch in from 4 to 8 days. The larvae grow very rapidly and gorge themselves on the foliage. They become full grown in from 10 days to 2 weeks. The mature worm is velvety and of a green color, very similar to that of the foliage, with a faint yellow stripe down its back and yellow spots on each side.

Luckily, some parasites were imported when the pest became established in the United States. One parasite purposely imported from Europe is a wasplike fly, which is known to have killed practically every worm at Washington, D. C., in 1904.

Since the pupae winter in the old cabbage refuse, it is necessary that such remnants be destroyed. Various methods of control are known, but the most satisfactory means is spraying or dusting with rotenone or pyrethrum.

FIGURE 125.—Sample of narrative report.

Procedure (identification); each member works separately:
1. Remove names from insects.
2. Assign a number to each insect.
3. Write number and name of insect.

Equipment (judging):

1. Twelve samples of injury caused by insects, each sample carrying a number.
2. Twelve specimens of economic insects, each specimen carrying a number.
3. Twelve samples of insecticides, each sample carrying a number.
4. Series of placards, each placard carrying a number and the name of a particular control practice, such as spraying, dusting, fumigation.
5. Forms to be filled out by contestants.

Contest Record Sheet

Injury sample	Insect	Insecticide	Control practice
Potato	Colorado potato beetle.	Lead arsenate	Dusting or spraying.

Procedure (judging):

1. Contestants work separately.
   - *a*. Select sample of injury. Write name of host in proper column on forms similar to the one preceding.
   - *b*. Identify insect which caused injury and write name (or number) in space.
   - *c*. Pick out insecticide used for control, and write its number in space.
   - *d*. Pick out control-practice placard and write its number in space.

MAKE PERMANENT EXHIBIT FOR SCHOOL OR COUNTY AGENT'S OFFICE

[Twelfth meeting—January]

Equipment:

1. Collections.
2. Glass-topped boxes for collections.
3. Material on life cycle of insects.
4. Mounts to be made up.

Procedure:

1. Select best specimens of representative insects.
2. Arrange by orders in glass-topped box.
3. Label insects plainly.
4. Make mounts of insect in different stages of life cycle and of material damaged.
5. Label material on mounts plainly.

THINGS TO KNOW ABOUT INSECTS

Club members should know something about the habits of the insects in their collections, and control of the pests. If a paragraph were written on each insect, this manual would be too large to be practical for the purpose for which it is intended. The key appearing on pages 54 and 55 (table 1) will prove helpful in aiding members to obtain the information they need regarding each common insect listed.

On page 53 is a completed questionnaire (fig. 126) in which capital letters indicate the 10 questions listed. To fill out similar questionnaires, turn to pages 54 and 55, on which appear a list of common insects arranged in alphabetical order. The capital letters appearing in table 1 correspond to those appearing in the questionnaire; following each insect name is a series of numbers arranged in columns under the capital letters. These numbers refer to like numbers on pages 55 and 56, which give the answers to the questions. For example, if an alfalfa caterpillar is the insect concerned, and we want to fill out a questionnaire, we turn to table 1, page 54, and find alfalfa caterpillar; then look for column A, which represents the

question, "What plant, animal, or its products afford food for this insect?" Opposite alfalfa caterpillar and under A, we find the number 2. If we turn to page 55 and look under A, we find that number 2 refers to alfalfa and clovers, which are the food of the caterpillar. By the same procedure all the questions for each insect

THINGS TO KNOW ABOUT INSECTS

Name of collector: John Doe

Place where collected: Town Piqua State Ohio

Name of insect: Common Imported cabbage worm

Genus Ascia Species rapae

Date collected: Day 15th Month June Year 1937

A. What plant, animal, or its products afford food for this insect?

Cabbage and related crops

B. What part of the food plant or animal is infested?

Leaves and head

C. In what stage does insect spend the winter?

Pupa

D. Where does insect spend the winter?

crop refuse

E. What kind of mouth parts has this insect?

Larva: chewing. Adult: sucking

F. Of what economic importance is this insect?

Pest

G. What is the injurious stage of this insect?

Larva

H. Control is directed toward what stage of this insect?

Larva

I. What control measures are recommended?

Spraying

J. What insecticide would be used?

Derris

FIGURE 126.—Sample of questionnaire.

may be answered. In table 1, if the mouth parts, controls, or other factors differ for the adult and larva, the top number refers to the adult and the bottom number to the larva. The reference for the codling moth indicates that control is directed to the larvae and that all control practices and materials refer to the larvae.

LIST OF COMMON INSECTS

Only a few of the more important insects found throughout the country are named in the list of common insects. In each community some will be found that are not included in the list. By studying literature on this subject, club members can familiarize themselves with facts regarding the insects in their own locality.

TABLE 1.—*List of common insects with a key to information on their life history, habits, and control*

[Column heads A through J correspond to questions on page 53. All numbers in table refer to information indicated by similar numbers listed under capital letters on pages 55 and 56]

Common name of insect	Stage	Question									
		A	B	C	D	E	F	G	H	I	J
Alfalfa caterpillar	Adult					66					
	Larva	2	32	48, 50	60	62	67	73	73	80, 86	116
Angoumois grain moth.[1]	Adult					66					
	Larva	21	34, 35	50	60	62	67	73	76	88, 90	105, 114
Apple aphid			31								
		3	32, 34	46	53	64	67	73, 75	76	97	112, 121
Armyworm [2]	Adult					66					103, 122
	Larva	7, 21	32	47, 50	57, 60	62	67	73	73	77	134, 139
Bagworm	Adult					66					
	Larva	23	32	46	60	62	67	73	73	89, 97	116
Bean weevil										88	
		4	34, 35	50	60	62	67	73, 75	76	90, 98	105
Bedbug									73		
		14, 1	40	50	54, 60	64	67	73, 75	75	97	111
Blister beetle	Adult	18	32, 33			62	67		75	86	109, 134
	Larva	15	44	47	57	62	68	75			
Boll weevil			31, 32						73	80, 83	101, 103
		8	33, 34	49	56	62	67	73, 75	75	86, 96	107, 139
Bollworm	Adult		33			66					
	Larva	18	32, 34	48	57	62	67	73	73	80, 86	107, 111
Brown chicken louse		20	40	50	60	62	67	73, 75	76	84, 86	111, 133
Cabbage aphid		6	32	46, 50	60	64	67	73, 75	76	86, 97	121
Cabbage looper [2]	Adult					66					111
	Larva	6, 18	32	48	55	62	67	73	73	86, 97	127, 128
Cankerworm	Adult					66			75	78	
	Larva	3, 23	32	48	57	62	67	73	73	86, 97	111, 116
Carpet beetles (buffalo moth, etc.).		11, 15								88, 96	106, 111
		25	39, 42	50	60	62	67	73, 75	76	97, 98	124, 139
Cat and dog flea		1	40	50	60	66	67	75	76	84	111
										86, 97	127, 128
Chinch bug	Adult	7, 21	28, 32	49	56	64	67	73	75	83, 100	
	Nymph	7, 21	28, 32			64	67	75	73	78	108, 112
Cicada	Adult					64	67	75	75	82	
	Nymph	23	26	47	57, 60	64					
Cattle grub		Cattle	40	47	60	65	67	73	73	86, 97	128
Clothes moth [1]	Adult					66			75	88, 96	106, 111
	Larva	11, 25	42	50	60	62	67	73	73	97, 98	124, 139
Cockroach										86	106, 111
		12	35	50	60	62	67	73, 75	73, 75	96, 97	127, 133
Codling moth [2]	Adult					66					
	Larva	3	34	47	56	62	67	73	73	83, 97	111, 116
Colorado potato beetle		19	32	49	57	62	67	73, 75	73, 75	86, 97	111, 116
											122
Corn earworm	Adult					66					
	Larva	18	32, 34	48	57	62	67	73	73	91	126, 139
Cotton flea hopper			28, 29								
		8, 18	30, 31	46	52	64	67	73, 75	76	80, 86	101, 107
Cotton leaf worm [2]	Adult	3, 10, 16	33, 34			64				86, 97	101, 103
	Larva	8	32			62	67	73	73		116, 122
Cricket (field)			43								
		15, 18	32, 36	46, 47	57, 56	62	71	73, 75	73, 75	77	103, 134
Cutworm	Adult					66					
	Larva	18	26, 28	47	57	62	67	73	73	77	122, 134
Dragonfly	Adult	15				62	68				
	Nymph	15		47	59	62	68				
Firefly		18	26, 36	47	57	62	71				
Granary weevil										88	105
		7, 21	34, 35	50	60	62	67	73, 75	76	96, 97	111, 114

[1] Numbers in columns I and J apply to both adult and larva of this insect.
[2] Numbers in columns I and J apply only to the larva of this insect.

TABLE 1.—*List of common insects with a key to information on their life history, habits, and control*—Continued

Common name of insect	Stage	Question									
		A	B	C	D	E	F	G	H	I	J
Grasshopper			31, 32							77, 80	106
		18	33, 34	46	57	62	67	73, 75	76	86, 97	107, 134
Harlequin bug										83, 86	
		6	32	49	60	64	67	73, 75	73	89, 97	128, 130
Hessian fly		21	28	47	60	65	67	73	76	80, 82	139
Honeybee		10	33	50	Hive	66	68				
Horse botfly		13	40	47	60	65	67	73	73, 72	91	105
Horsefly		1	39	47	57	64	67	75		92	
House ant										77, 86	106, 111
		12, 14		50	54, 57	62	67	75	76	88, 97	132, 139
Housefly	Adult	12, 14		50	54		67		75	97	111, 139
	Larva		36			65, 66		75	73	96	
Imported cabbage-worm.[2]	Adult					66					111
	Larva	6	32	48, 50	55	62	67	73	73	86, 97	127, 128
Japanese beetle	Adult	18	32, 34			62	67	73	75	97	111
	Larva	21	26	47	57	62	67	75	73	80	139
Ladybeetle		15	44, 45	49	56	62	68				
Mantid		15	44, 45	46	53	62	68				
Melon aphid		8, 9	31								
		18	32, 33	46, 50	52	64	67	73, 75	73, 75	86, 97	121
Mexican bean beetle.			32, 33								
		4	34	49	56	62	67	73, 75	73, 75	86, 97	109, 128
Mites:											
Animal		1	40	50	51, 54	64	67	73, 75	73, 75	84, 91, 97	139
Flower			27, 31								139
Vegetable		3, 18	32, 34	46, 50	60	64	67	73, 75	76	86	135, 139
Tree			32								139
Shrub		23	33, 34	46	53	64	67	73, 75	76	97	121, 128
Mosquito									73	85, 96	111, 126
		1	40	50	51	64	67	73, 75	75	97	127, 139
Onion thrips			32								
		18	33, 34	49	55	65	67	73, 75	76	86, 97	111
Pea aphid			31								
		2, 17	32, 34	46, 49	60	64, 66	67	73, 75	73, 75	86, 97	111, 128
Peach borer	Adult					66					
	Larva	16	28	47	60	62	67	73	73	88	124, 139
Stalk borer	Adult					66					
	Larva	18	28	47	55, 60	62	67	73	73	83, 96	
Wireworms (click beetles)		18	26, 27	47	57, 60	62	67	73	73	88, 95	113, 139

ANSWERS TO QUESTIONNAIRE

A. Food, plants, animals, or their products:

1. Animals, many kinds.
2. Alfalfa and clovers.
3. Apples and pears.
4. Beans.
5. Books and papers.
6. Cabbage and related crops.
7. Corn.
8. Cotton.
9. Cucumbers, melons, and squash.
10. Flowers.
11. Furs.
12. Food products.
13. Horses and mules.
14. Annoyance.
15. Other insects.
16. Peaches.
17. Peas.
18. Plants, many kinds.
19. Potatoes.
20. Poultry and birds.
21. Small grains and grasses.
22. Tomato and tobacco.
23. Trees in general.
24. Wood and wood products.
25. Woolens.

B. Part of host infested:

26. Roots.
27. Bulbs or tubers.
28. Main stem or trunk.
29. Bark.
30. Branches.
31. Buds or squares.
32. Leaves.
33. Blossoms.
34. Fruits or grains.
35. Stored plant products.
36. Decaying vegetation.
37. Paste, glue, starch.
38. Lumber.
39. Hide or leather.
40. Flesh or blood.
41. In intestines.
42. Dried hair and feathers.
43. Decaying animal matter.
44. Eggs (insect).
45. Young and adults (insect).

C. Stage in which insect spends the winter:

46. Egg.
47. Immature stages.
48. Pupa.
49. Adult.
50. All stages (in South or in heated buildings).

D. Where insect spends the winter:

51. Animals.
52. Alternate host.
53. Branches of trees.
54. Buildings.
55. Crop refuse.
56. Protected places in general.
57. Soil.
58. Stored products.
59. Water.
60. Where it fed.
61. Woody portion of plants.

E. Mouth parts:

62. Chewing.
63. Lapping.
64. Piercing and sucking.
65. Rasping.
66. Sucking.

F. Economic importance:

67. Pest.
68. Beneficial.
69. Larva beneficial.
70. Adult beneficial.
71. Questionable importance.

G. Injurious stage:

(Same numbers as H.)

H. Control directed toward:

72. Egg.
73. Immature stage.
74. Pupa.
75. Adult.
76. All stages.

I. Control measures:

77. Baits.
78. Banding or barriers.
79. Burning.
80. Culture.
81. Date of harvesting.
82. Date of planting.
83. Destroying hibernating quarters.
84. Dipping.
85. Drainage.
86. Dusting.
87. Hot-water treatment.
88. Fumigation.
89. Hand picking or squeezing.
90. Heating.
91. Medication.
92. None satisfactory.
93. Parasite.
94. Pruning.
95. Rotation.
96. Sanitation or crop-refuse destruction.
97. Spraying.
98. Store products in tight container.
99. Trapping.
100. Use plants of resistant varieties.

J. Insecticide to use:

101. Benzene hexachloride.
102. Bordeaux mixture.
103. Calcium arsenate.
104. Calcium cyanide.
105. Carbon disulfide-carbon tetrachloride.
106. Chlordane.
107. Chlorinated camphene.[3]
108. Creosote.
109. Cryolite.
110. DD mixture (dichloropropylene-dichloropropane).
111. DDT (dichloro diphenyl trichloroethane).
112. Dinitro compounds.
113. Ethylene dibromide.
114. Ethylene dichloride-carbon tetrachloride mixture.
115. Hydrocyanic acid.
116. Lead arsenate.
117. Lime-sulfur.
118. Methoxychlor (methoxy analog of DDT).
119. Methyl bromide.
120. Naphthalene (moth balls and flakes).
121. Nicotine.
122. Paris green.
123. Parathion.
124. PDB (paradichlorobenzene).
125. Pentachlorophenol.
126. Petroleum oils.
127. Pyrethrum.
128. Rotenone (derris and cube).
129. Ryania.
130. Sabadilla.
131. Smear 62 (diphenylamine preparation).
132. Sodium arsenite.
133. Sodium fluoride.
134. Sodium fluosilicate.
135. Sulfur (dusting).
136. TDE (dichloro diphenyl dichloroethane) (DDD).
137. Tetraethyl pyrophosphate.
138. Thiocyanates.
139. Your county agent can give you additional information about the foregoing insecticides.

[3] Now known as toxaphene.

INSECTICIDES

We get most of the insecticides that have been in use for a long time from metallic compounds or from plants. Those of metallic origin, such as lead arsenate, are inorganic insecticides; those from plants, such as nicotine from tobacco and pyrethrum from the pyrethrum flowers, are organic. Organic chemicals that are prepared in the laboratory (synthetic organic chemicals), such as paradichlorobenzene, are also used. Beginning with DDT, a number of new synthetic organic insecticides have been developed. These are made of elements such as carbon, hydrogen, oxygen, and chlorine, combined in such a way as to form very complex chemical compounds. For example, the chemical name of DDT is dichloro diphenyl trichloroethane. The initials are the first letters of each part of the name.

When insecticidal chemicals are first developed, they are not well standardized. The technical chemicals (commercial grade) should be used as insecticides only when they are properly prepared in formulations (mixtures) that can be used as dusts, sprays, or aerosols. Thus, we have five general types of DDT formulations: (1) Powders, to apply as a dust; (2) wettable powders, or powders that will mix easily with water, for spraying; (3) emulsion concentrates, to be diluted (made weaker) by adding water and applied as a spray; (4) solutions, to be applied without dilution; and (5) aerosols, to be applied in the form of fine mist or smoke. Most other synthetic organic insecticides are prepared in similar formulations.

Residual sprays, space sprays, and aerosols are new terms that have come into use since the new insecticides were developed. A residual spray is one that when placed upon walls and other surfaces leaves a residue (fine particles or crystals) that is effective for some time against insects that crawl or rest on the treated surfaces. Space sprays and aerosols are released into the air as a fog or mist. The minute insecticide particles in the air come in contact with the insects and kill them.

Some of the new insecticides can be applied in concentrated form and in very small amounts per acre. In fact, against certain forest insects, as little as ½ to 1 pound of DDT to 1 gallon of solution to the acre has been found to give good control. This has made airplane spraying practical, because there is no need for hauling a lot of excess liquid.

Many of the old types of spraying and dusting equipment may be used for applying the new insecticides. However, new types of application equipment are being developed, such as mist blowers, fog generators, and improved devices for dispersing insecticides from the air.

The new synthetic organic insecticides are finding a useful place by expanding the range of effective and economical insect control. They will probably not completely replace the insecticides in use before DDT was developed. No material yet developed has been found effective for practical use against all insect pests. In fact, different formulations of a given material may vary in effectiveness against the same insect species. Years of testing under many different conditions are usually necessary to determine the value of each material and formulations of it against different kinds of insects. The

possible harmful effects of an insecticide on plants, animals, and soil must be determined also before it can be safely recommended for a given use.

The new synthetic organic insecticides, like many of the materials previously in use have certain disadvantages. Most of them are poisonous to higher animals, including man. Thus, such material should not be used on fruits and vegetables when fruit or foliage that is to be eaten is on the plants, unless the poisonous residues are removed by weathering or can and will be removed by artificial means. Follow recommendations when you apply any insecticide. If you use too much you are wasteful, and to do so may be harmful.

In handling, mixing, and applying insecticides that are poisonous to human beings, be especially careful not to inhale excessive quantities.

After working with such materials, wash your hands or any exposed part of your body thoroughly. Label the containers plainly in which these insecticides are kept or stored, and place them out of reach of children or of persons who would be careless in their use.

PART III.—TELLING OTHERS ABOUT INSECTS

[Introduction to third-year work]

Members of the group organized for third-year insect study will, in addition to continuing with insect collecting, be ready to carry to other club members and to adults their knowledge gained from previous study. The third-year outline of work should include giving plays and demonstrations, preparing and displaying exhibits, and making surveys. Through these devices, entomologists and extension workers may be aided in getting correct insect-control information into the hands of many persons who otherwise would not be reached. The great number of insects and the wide variety of control practices provide almost limitless work for club members to do in this field.

COLLECTION AND IDENTIFICATION

There is a difference of opinion as to the total number of orders of insects, but it is about 25. Representatives of some orders are very rare and would seldom be picked up for collections. However, seven orders, in addition to those already described, are listed here, and specimens of some of them can be located with sufficient effort.

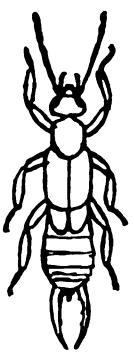


FIGURE 127.—Earwig.

DERMAPTERA.—Derma (skin), pteron (a wing). Front wings beetlelike (leathery), but much shorter than abdomen. Hind wings earshaped, veins radiating from middle forward margin. Often wingless. Cerci (forceplike structures) on tip of abdomen. Mouth parts for chewing. Life changes (metamorphosis) incomplete. Earwigs.

FIGURE 128.—Booklouse.

CORRODENTIA.—Corrodens (gnawing). Minute insects, wingless or with four membranous wings with few prominent veins; wings, when present, folded rooflike over body. Mouth parts for chewing. Life changes very slight. Booklice, dust lice, bark lice, deathwatches.

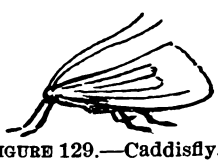


FIGURE 129.—Caddisfly.

TRICHOPTERA.—Thrix, genitive trichos (a hair), pteron (a wing). Four similar membranous wings; hind pair shorter and broader. Mouth parts modified for chewing. Antennae long, legs long. Life changes complete. Larvae living in water. Caddisflies.

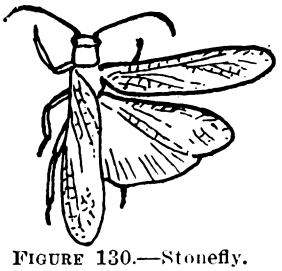


FIGURE 130.—Stonefly.

PLECOPTERA.—Plecos (plaited), pteron (a wing). Four netted, veined wings, front pair narrow, hind pair very broad and folding like a fan, folded flat on abdomen when at rest. Mouth parts for chewing. Life changes incomplete. Stoneflies.

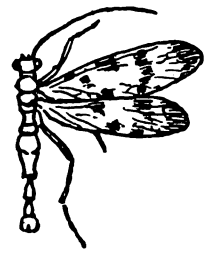


FIGURE 131.—Scorpion fly.

MECOPTERA.—Mecos (length), pteron (a wing). Four long, rather narrow wings, with numerous cross veins. Mouth parts elongated into a snout three times as long as width across the eyes; chewing portion of mouth parts at end of snout. Life changes complete. Scorpion flies.

FIGURE 132.—Springtail.

COLLEMBOLA.—Colla (glue), embolon (a bolt or bar). Tiny, primitive, wingless insects. Mouth parts for chewing, sunken into head. Never more than six abdominal segments. First segment with a forked adhesive organ or ventral tube. Fourth segment with a forked spring, which the insect uses to flip itself along. No metamorphosis, that is, no changes in form during the life cycle. Springtails.

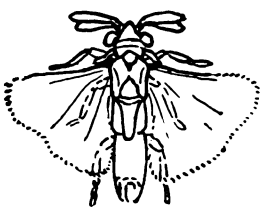


FIGURE 133.—Twisted-wing parasite.

STREPSIPTERA.—Strepsis (a turning or twisting), pteron (a wing). Four wings, front pair reduced to mere clubs, hind pair triangular. Eyes stalked, degenerate. Mouth parts for chewing. Mouth parts mere vestiges. Wormlike insects, living throughout life in the interior of other insects. (Females without wings, eyes, or antennae.) Twisted-wing parasites.

CALENDAR OF ACTIVITIES, THIRD YEAR

Meetings	Telling others about insects
First, February	Organization.
Second, March	Outline work.
Third, April	Playlets. Surveys.
Fourth, May	
Fifth, June	Demonstrations.
Sixth, July	
Seventh, August	Exhibits.
Eighth, September	
Ninth, October	Fall surveys.
Tenth, November	
Eleventh, December	Playlets.
Twelfth, January	

PLAYLETS

Playlets can be effective teaching devices. There is no question that through playlets many people can be "shown the light" to better insect control when dramatic situations dealing with the solution of some

local problem are cleverly presented with sufficient wit and humor to lighten the serious thought back of the play.

Young people engaged in insect study should be encouraged to take the initiative in writing their own playlets to suit local conditions, and then cast them in harmony with the talent available. This procedure should be helpful in stimulating originality and sustaining interest among the club members concerned.

Each member who takes part in a playlet should keep in mind that in portraying a character he should be natural; avoid acting too mechanically; try to speak smoothly—not hesitate; practice to impersonate the character he is to represent.

DEMONSTRATIONS[4]

Demonstrations provide club members with the opportunity actively to study the details and technicalities of insect control, especially in relation to insects that are prevalent in their own communities. Club members themselves not only become well informed, but are thereby better prepared to pass this information on to others.

The damage done by an insect, how it lives (life cycle), its feeding habits and methods of control, constitute major points which should be well developed in any 4-H team demonstration dealing with insect control. These points are outlined a little more in detail in the sample outline on pages 62 and 63. Club members may use this guide in planning a team demonstration on the control of any insect or insects found in their community, as, for example, insects on flowers, or peach borer control.

A club tour or a survey of the various kinds of insects found around their homes and in their communities not only will aid club members in the selection of a demonstration subject having much practical value and worthy of being demonstrated, but will furnish them with helpful, important data for the development of their demonstration. (Note points listed under introduction in outline, page 62.)

The insect, the host,[5] and some evidence of the damage caused by the insect should be shown in the introduction. A chart or poster presenting important data on the insect or demonstration subject, resulting possibly from a club survey, makes the introduction more convincing because it helps to emphasize the need for good control methods.

In presenting the demonstration, material such as models of insects or charts should be kept out of sight except when in use. When these materials are being used in the demonstration, they should be handled in such a way that they are plainly visible to the audience. Diagrams or charts will help to illustrate the feeding habits and different kinds of mouth structures of insects, and other minute processes and structures.

To have their demonstration fundamentally sound and complete, club members should make an exhaustive study of all the subject-matter material available relating to their demonstration. In addition to using the material in this manual, club members may consult

[4] Demonstrations may be given at the fifth meeting, in June, and the sixth meeting, in July. See calendar of activities for third-year work, p. 60.

[5] The host of an insect is the plant or animal or its products on which the insect feeds, such as cabbage for the cabbageworm or furs and woolens for the clothes moth.

such well-informed persons as the county agricultural agent, club agent, or extension specialist, and obtain bulletins from them on the particular subject being demonstrated.

SAMPLE OUTLINE FOR TEAM DEMONSTRATION ON INSECT CONTROL

Demonstrator's name_____	Demonstrator's name_____
1. Introduction (talking and showing). Reasons for giving demonstration: Kinds of insects prevalent in community. Damage done by these insects. Most important insect in community: Host of this insect. Nature of damage by this insect. Economic or aesthetic value of host.	
(No talking.) Demonstrator assists teammate with work. Furnishes teammate with equipment and supplies as needed.	2. First part of demonstration (talking and working). A. Habits of the insects: (1) Time of year and place where the different life stages (egg, larva or nymph, pupa, and adult) are found. B. Relation of habits to control: (1) Feeding. *a.* Chewing. *b.* Sucking. (Under cover or out in open.) (2) Where insects spend the winter. (3) Migration (check by barriers). (4) Others.
3. Second part of demonstration (talking and working). A. Control methods: (1) Insecticidal. *a.* Kind. *1.* Name of poison. *2.* Contact or stomach poison. *b.* Cost. *c.* Method of mixing insecticide. *1.* Dilution. *2.* Procedure. *d.* Methods of application. *1.* Dusting, spraying, fumigation, or medication. *2.* Place to apply poison. *e.* Time of application. *f.* Number of applications. *g.* How long is insecticide effective?	(No talking.) Demonstrator assists teammate with work. Furnishes teammate with equipment and supplies as needed.

h. Time required to kill insect. (2) Other methods. *a.* Hand picking. *b.* Cultural practices. *c.* Management practices. *d.* Sanitary measures. *e.* Natural control. *1.* Parasites. *2.* Predators.	
(No talking.) Demonstrator assists teammate with charts, posters, and all equipment necessary for summarizing all important points of demonstration.	4. Summary (talking and showing). A review of all important points considered in demonstration. Use charts, posters, and any type of illustrative material necessary.

There is almost no limit to the number of insect-control practices that lend themselves to team demonstrations. Below are listed a few suggestive topics which may be developed according to the sample outline given. The subheads under each topic are control methods that should be demonstrated.

1. Controlling the clothes moth and carpet beetle.
   a. Spraying.
   b. Brushing, sunning, and airing.
   c. Cleaning and storing.
   d. Fumigation.
2. Controlling stored grain insects.
   a. Cleaning bins.
   b. Spraying bins.
   c. Fumigation.
3. Controlling the cattle grub.
   a. Spraying.
   b. Dusting.
   c. Washing.
4. Controlling the screwworm.
   a. Medication.
   b. Prevention of wounds.
5. Controlling lice on animals.
   a. Dipping.
   b. Spraying.
   c. Dusting.
6. Controlling the peach tree borer with paradichlorobenzene.
7. Controlling vegetable garden insect pests.
8. Controlling flower insect pests.
9. Controlling houseflies.
   a. Sanitation.
   b. Screens.
   c. Sprays.
10. Mixing poison bait for use in grasshopper and cutworm control.
11. Mixing poison sirup for use in house-ant control.

In addition to the team demonstrations on insect control, there are many other phases of the work with insects that can be presented by individual demonstrations. They are simple processes that may become part of a team demonstration. The following items may offer a few suggestions:

1. Preparing insects to be sent away for identification.
2. Making a collection net.
3. Making a jar for killing insects.
4. Pinning insects.
5. Making a spreading board.
6. Spreading butterflies.
7. Mounting butterflies for ornamental use.

EXHIBITS[6]

The primary object of an exhibit is to create interest. It is often difficult to tell an entire story with an exhibit. Quite frequently when people go where exhibits are shown, they do not take time to make a complete study of the whole exhibit. For these reasons, exhibits must be simple and so built that they will suggest the story without the use of too many legends.

[6] Exhibits may be given at the August and September meetings. See calendar of activities for third-year work, p. 60.

Exhibits should create enough interest to influence the observer, when he sees an article or bulletin on the subject, to want to read it and know more details of that particular subject. If one of the purposes of the exhibit is to show insect damage to a plant or animal, living specimens should be used whenever possible, and arranged in their natural position and surroundings.

In displaying control measures, the major steps in procedure may be shown. For instance, in peach borer control, use three trees or stumps. Around one have the ground leveled off and free of stones and trash. Around another show the position of the chemical, and arrange the third to show the job completed with the soil mounded up around the tree.

Whenever possible, have the life stages of the insect and the material to be used in control in conspicuous places, where persons who wish to examine them more closely may do so.

SURVEYS [7]

Through surveys it is possible to locate areas of heavy insect population and arrange to apply control measures before damage occurs. Where certain control measures are to start with given populations of the insect, surveys are very important. Entomologists make surveys every year, but conditions do not permit them to cover every farm or even every county. Reports by local people often will help the entomologist to locate threatening numbers of insects that might otherwise be overlooked until after damage occurs. Information on the abundance of many insect pests not mentioned in this manual would be valuable.

The information gained from surveys with reference to the cotton boll weevil, for example, would be important. The early spring survey to be made about the time cotton is chopped would indicate the number of weevils emerging from hibernation. When 40 or more weevils per acre are present on any given field, control measures are likely to be necessary on that field, and arrangements for applying such measures should be made.

The square-infestation survey should be made on each field when the cotton begins to fruit, to determine when 10 percent of the squares are infested. If cloudy, rainy weather, which is favorable to boll weevil development, prevails, dusting with calcium arsenate should be started.

Possibly one of the best examples of the effectiveness of surveys is that made for the hessian fly. Through a survey made each summer by entomologists, the danger of hessian fly infestation in wheat sown in the fall is determined, and if necessary the farmers are warned to observe the safe seeding dates. Club members in territory where the hessian fly is prevalent could, by familiarizing themselves with the survey, do much to assist entomologists, as well as to educate farmers, regarding the value of withholding planting until after the safe seeding date.

[7] Surveys may be given at the October and November meetings. See calendar of activities for third-year work.

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