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FREDERICK J. H. MERRILL, *Director*

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APRIL 1899

COLLECTION, PRESERVATION

AND

DISTRIBUTION OF NEW YORK INSECTS

By

EPHRAIM PORTER FELT, D. Sc.

State Entomologist

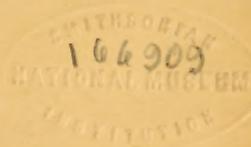
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PREFACE

The organization of a corps of voluntary observers makes it necessary to issue directions for collecting and shipping insects. It is believed that the chapter on the distribution of insects will be a valuable guide in directing observations along lines hitherto largely ignored. This bulletin has also in view the guidance of pupils who, for a small compensation, may undertake to collect insects for the state. It was thought best to include directions for preserving insects, in order to encourage younger students to build up collections of their own.

No claim is laid to originality in the text of this bulletin, as available sources of information have been freely consulted. The illustrations are all original, having been prepared under my direction by my assistant, Mr C. S. Banks.

EPHRAIM PORTER FELT
State entomologist

COLLECTING INSECTS

With a little experience it is usually easy to collect insects very successfully, provided one gets rid of the notion that the more common forms are unworthy his attention. I have repeatedly seen students who were required to make a collection, spend more time begging insects than it would take to catch them. A beginner must be content at first to take those he can see, and then as eye and muscles become trained, he will soon be able to secure those of greater value.

Collecting bottle. First provide at least a collecting jar or bottle. For most insects, except the larger ones, a wide-mouthed vaseline bottle is very convenient, but certain butterflies, moths and other insects with a considerable wing-spread should be put in a larger bottle or jar with a proportionately wider mouth. In order to prevent specimens from injuring themselves, the jar should be charged with potassium cyanide, but as this is a deadly poison it must be handled with care and the bottles might be more safely prepared by a druggist or teacher. The usual method is to put in the vaseline bottle two or three pieces of cyanide about twice the size of a pea (more if a larger jar is used), pour in just enough water to cover the poison, and then add at once enough plaster of paris to take up the water. With a cloth wipe out the upper portion of the bottle and allow it to stand uncorked till the plaster has hardened and the inside is dry. Then cork tightly, label the bottle **Poison**, and in a few hours it will be ready for use. Do not have the bottle open more than is necessary as the cyanide loses strength rapidly. Those afraid of this dangerous substance can add chloroform to a little cotton kept in place by a disk of blotting paper and use that in the collecting bottle. But as chloroform requires frequent renewal and is not so deadly to insect life, the cyanide bottle is generally preferred, and with reasonable care need not be feared. With no farther outfit many insects can be captured by advancing the open bottle and partly pushing and partly driving the specimen in with the cork. A little



FIG. 1 Collecting bottle (original).

in the collecting bottle. But as chloroform requires frequent renewal and is not so deadly to insect life, the cyanide bottle is generally preferred, and with reasonable care need not be feared. With no farther outfit many insects can be captured by advancing the open bottle and partly pushing and partly driving the specimen in with the cork. A little

practice will be found necessary before the more wary species can be taken in this manner.

Insect net. Those wishing to secure butterflies, moths and other rapid flying insects will have much use for a net. This may either be bought or made at home. It consists of a stout handle, a broom handle

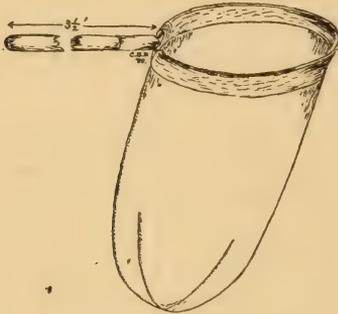


FIG. 2 Butterfly net (original).

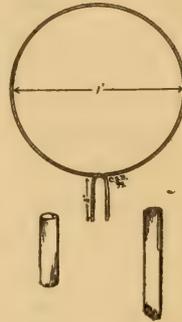


FIG. 3 Details of net rim (original).

about 1 meter ($3\frac{1}{3}$ ft) long will answer, to which is securely fitted a $\frac{1}{2}$ cm ($\frac{3}{16}$ inch) wire ring 30 cm (about 12 in.) in diameter, bent as indicated in figure 3 and firmly held by a ferule. The ring can easily be made and attached by a tinsmith or blacksmith. The net itself should be a little shorter than the collector's arm, preferably of cheese cloth and firmly sewed to a thicker band around the ring. The bottom of the net may be cut square, forming two corners, or better, cut round

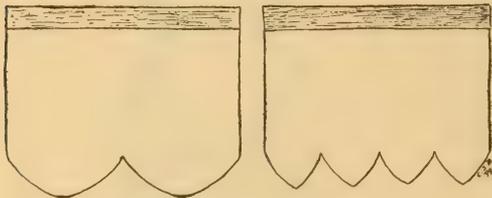


FIG. 4 Patterns for net bottoms (original).

or into four angles and brought down to a point, as represented in figure 4, thus doing away with corners which are apt to be troublesome. Those wishing a nicer article

can buy of dealers in entomologic supplies various styles of nets ranging in price from \$1 to \$2.50. For \$1.50 a very desirable net with jointed handle and folding frame can be secured. When using the net approach the insect cautiously and with a quick swing and turn of the handle it is captured. It does not pay to chase insects. Transfer captures directly from the net to the cyanide bottle, as the less insects are handled the

greater their value. Usually it is comparatively easy to place the open bottle over an insect in the net and induce it to enter without touching it.

Those wishing to collect water insects will find a shallow net of coarse material much more convenient than the ordinary butterfly net, because the mesh of the latter is too fine to permit moving it rapidly through the water.



FIG. 5 Dip net (original).

Collecting box. Those interested in butterflies and moths will find a collector's box of great service. This is a flat box just deep enough to hold pinned specimens and having a layer of cork on the bottom. It may be made specially, or a cigar box of convenient size for carrying may be utilized. Some collectors merely attach a short piece of leather with a buttonhole in the free end, and when in the field the box hangs from a convenient button. Others use a strap swung over the shoulder.

Folded papers for butterflies. Butterflies may be killed in the net by pinching the thorax between the fingers, taking care that the wings are folded back before touching the insects. They are then placed in papers as represented in the accompanying diagram, the slip being proportionate to the size of the insect, and the locality and date placed on the outside. Specimens may be sent through the mails without injury in such papers.

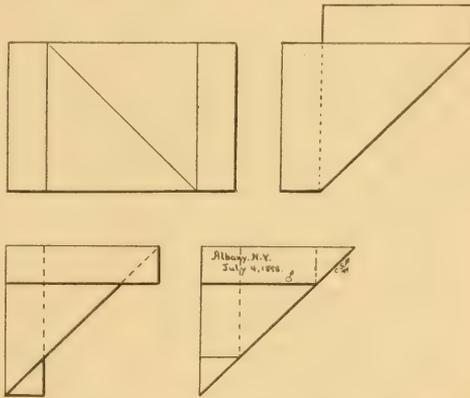


FIG. 6 Method of folding butterfly papers (original).

Vials and small boxes.

It is well to carry on a collecting trip a number of vials and small boxes in which insect eggs, larvae, etc., with a little of their food plant, can be kept for closer examination later. For soft bodied insects several of the vials should contain 50% alcohol.

Capturing insects. The beginner will soon learn that certain localities are more productive than others and that the time of day has considerable influence on insect activity. It would be well, though by no means necessary, to take the first trip or two on bright warm days in

company with one who has done some collecting, and plan the course so that diversified country will be traversed. Insects may be found in almost any place, but experience will soon teach the most favorable



FIG. 7 Pistol case bearer (original).

localities. At first take everything, thus training eye and muscle, and learning a little of the varied forms of life. The collector will soon find that beetles, bugs and other insects can not be put in the same bottle with certain forms without becoming covered with scales, and if ambitious to secure nice specimens, he will have a special bottle for butterflies and moths. Dragon flies are also best kept in a large bottle by themselves. Large insects injure the smaller ones and it will be found that numbers of water insects can not be put in with others without injury to many of the more delicate terrestrial forms. Hence, the necessity of treating collected insects differently, and the immense number of forms to be studied, will

soon compel specialization to a certain extent. That is, all those belonging to one order, as the butterflies and moths, the beetles, etc., or those attacking a few related plants or occurring in certain localities will be collected in preference to all others, and in this way many valuable facts are ascertained, which would be impossible were general collecting continued indefinitely, and at the same time much pleasure may be derived from the pursuit.

The actual method of procedure can hardly be described. In a general way walk rather slowly, pausing to examine a cluster of flowers, to look under stones, to examine the trunk and branches of trees, rotting wood, etc. After a little practice it will be surprising to see how many species on flowers can be taken with nothing but the collecting bottle. Many insects belonging to the bee and wasp family, some very handsome beetles, interesting members of the true bug family and a few flies can be captured in this manner. As some beetles and bugs drop readily to the ground, the bottle should be held a little below the insect. Dark colored, rapid running ground beetles may be found under stones and will require quick work to catch them. Trunks and branches of trees repay a careful examination. On the



FIG. 8 Cocoons of apple *Bucculatrix* (original).

smoother bark, sometimes hardly visible, there may be scale insects sucking the vital fluids from the tissues beneath, while numerous forms take shelter under loose edges of the rougher bark. Caterpillars of various kinds may be found crawling on the trunk or resting on the smaller twigs and sometimes resembling their support so closely as to require a practised eye to detect them. In winter and early spring the peculiar case bearers, the cocoons of the apple *Bucculatrix*, and the more concealed winter retreats of the bud worm can be found only by close inspection. Then there are the eggs of various species, some times in clusters on the bark or even in belts around the limbs, as in the case of the apple and forest tent caterpillars. Minute particles of sawdust hanging from a slender thread or lying at the

base of the trunk indicate the presence of borers. In a similar manner examine the foliage quietly and carefully. Various larvae, some moths, leaf-feeding beetles, bugs, etc. may be found and by holding the net or an inverted umbrella under a bough and beating it with a stick other good specimens can be obtained. When it is remembered that 371 species of insects are known to attack the apple tree or its fruit in one way or another, some idea will be obtained of the possibilities in collecting. Every part of a tree — root, stem and branch, flower, leaf and fruit — will repay examination. A person who will take one plant and study thoroughly the insects occurring thereon throughout the year can hardly avoid making a rich contribution to the world's fund of knowledge.



FIG. 9 Egg belt of apple tent caterpillar, enlarged (original).

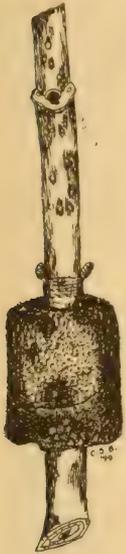


FIG. 10 Egg belt of forest tent caterpillar, showing a few exposed eggs, enlarged (original).

The insects inhabiting a meadow, those living in sandy places, aquatic or alpine forms, all offer inviting fields to the student of nature, and in each the collector will find much of interest. In meadows or grass land and other places where there are not too many obstructions, sweeping with the net results in the capture of many species. The collector advances across the field swinging his net vigorously to one side just above the herbage, or even hitting the taller plants, and at the end of the stroke turns the net quickly and reverses the movement, thus produc-

ing a continuous sweep which is maintained till considerable material is taken. The desirable specimens are then removed from the net and the operation continued. In sandy places the fauna is rather scantily represented by ground beetles, tiger beetles, grasshoppers, etc., requiring closer search to secure many forms. Among the more interesting insects are those inhabiting water.

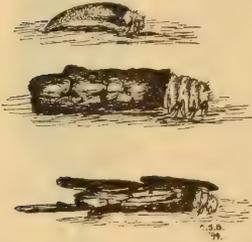


FIG. 11 Caddice fly larvae and cases (original).

Caddice fly larvae with their peculiar cases may be found at the bottom of streams and ponds; on the under sides of stones the curious larvae of stone flies occur; among weeds and decaying matter the strange water scorpion moves slowly, its long legs and slender body suggesting the walking stick, which is, however, a very different insect. In ascending a mountain a good idea of the effect of climate is obtained by a study of insects. As the altitude increases certain species become less abundant and forms

relatively scarce in the lower regions begin to appear in numbers. A striking example of this is seen in the arthemis butterfly, *Basilarchia arthemis* Drury, a northern insect with a range closely limited by the southern boundary of New York state. In the lowlands it is relatively scarce, while in the higher regions near and in the Adirondack and Catskill mountains it abounds on account of the more congenial climate. At a moderate altitude insects are numerous but they differ in species from those below, and at extreme heights the fauna becomes scanty with an increase of wingless species. The latter peculiarity is also noticeable on smaller islands and may be explained by the strong winds of such places carrying away flying insects and thus favoring wingless forms.

Collecting at lights and sugaring. The attraction light has for insects is well known, and is frequently taken advantage of by collectors, who secure valuable specimens in this way. In many places all that is necessary is an open window in a lighted room. Dark, warm nights accompanied by rain are usually the most productive. In cities the electric arc lights attract many insects and may be visited with good results.

Examples of the family Noctuidae or owlet moths (many are known to the farmer in the larval state as destructive cutworms) can probably be secured in no better way than by sugaring. This consists in smearing a mixture of sugar and vinegar on the trunks of a number of trees or on fences in a favorable locality. Stale beer added to a mixture of sugar or molasses and water makes a very effective preparation. The bait is

applied at dusk to a number of places, and each desirable specimen is taken with the aid of a light by placing a wide-mouthed cyanide bottle over it while feeding. The moth will usually enter the bottle at once or can be induced to do so by a slight lateral movement of the poison jar, and then the cork can be replaced. If it is a good night, the collector will need at least two cyanide bottles in order that dead specimens may not be injured by later captures, the moths being transferred to the second jar as they become quiet.

Immature forms. Collecting insects in the pupa or quiescent stage is a ready means of securing perfect adults. Aside from rearing caterpillars, this is the only method of obtaining the more perfect examples of butterflies and moths, and is quite extensively practised. Cocoons may be found hanging from limbs, particularly on the lilac, lying on the ground enveloped in leaves, or securely tucked in many a sheltering crevice of tree, stone and fence. A large number of caterpillars enter the ground to a slight depth and transform in rude earthen cells. It is not difficult to find pupae in the soil, particularly in forests. They can be obtained in large numbers in fields where army worms have been abundant.

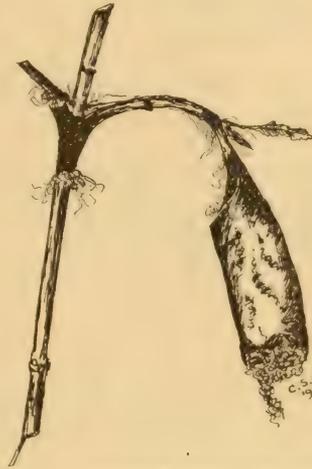


FIG. 12 Promethea cocoon on lilac, slightly reduced (original).



FIG. 13 Pupa of imperial moth (original).

Most collectors pay exclusive attention to the adult insects, and only in the exceptional cases of a few well-known forms are caterpillars considered worth bothering with. As we unfortunately know comparatively few insects in their adolescent stages, this has stood in the way of their study, specially as larvae are rather difficult to preserve nicely and only in the hands of the skilful can be made attractive. Nevertheless the collection and study of immature forms, notably caterpillars, offer a very inviting field to one who delights in the unknown. Their habits, adaptation to conditions, protective coloring, etc., are very interesting and profitable lines for inquiry, and when larvae of all orders are included, the student has before him an exceedingly rich field. It is nearly impossible to find a place in nature that is not capable of supporting insect

larvae. They may be found devouring the entire substance of leaves, eating only the softer under portions or even mining between the upper and lower epidermis. They closely simulate the appearance of a twig, bore within it or the trunk, inhabit all manner of vegetable matter, food stuffs, etc., are found in the alkali lakes of the west and one species is known to live in crude petroleum in the vicinity of oil wells, showing to what a wonderful extent the various forms of life can adapt themselves to conditions.

PRESERVING INSECTS

Most insects can be preserved by pinning and drying, but to attain the best results it will be necessary to have a few supplies and to follow certain tested rules.

Insect pins. Entomologists prefer insect pins made specially for this purpose. Those most extensively used in this country are from 3.5 to about 4 cm ($1\frac{3}{8}$ to $1\frac{5}{8}$ in.) long, are more slender than ordinary pins and are made in several sizes, the more convenient being nos. 1, 3 and 5 of the Kläger pins, no. 3 being the best if but one size is used.

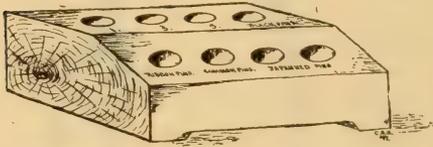


FIG. 14 Block for holding pins (original).

A convenient means of keeping several sizes and kinds of pins is a light block of wood about three fourths as deep as the pins are long with a 2-centimeter (nearly $\frac{1}{2}$ in.) hole for each size of pin. Kläger pins or those of other makes may be obtained from dealers in entomologic supplies. A black japanned pin is preferable to the unprotected or white pin as there is less liability of verdigris spoiling the insect. The trouble with the black pin is found in its lack of stiffness, specially in the smaller size.

Pinning block. For the best appearance of the collection the insects should be fixed on the pins at a uniform height. The beginner can accomplish this most easily by using a pinning block, a small piece of wood with a thickness equal to one fourth the length of the pin and with a hole through it large enough to admit the pin head. When mounting, thrust the pin nearly through the insect and then push it back to its proper place by reversing the specimen and sticking the head of the pin through the hole in the pinning block. If desired, labels and

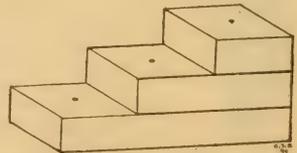


FIG. 15 Pinning block (original).

insects mounted on points can be fixed at uniform heights by using a pinning block composed of three pieces one fourth the length of the pin, and with holes through the center of each step. The lower one can be used for spacing insects and labels, the second one also for labels and the third for small insects on card points.

Rules for pinning. Many entomologists prefer to have about one fourth of the pin above the specimen, and this can be secured easily by using the pinning block described above. Experience has taught that not all insects can be pinned alike with the best results. As a rule the pin is thrust through the middle of the thorax, care being taken to have the insect straight on the pin. Among beetles however this procedure would result in spread-

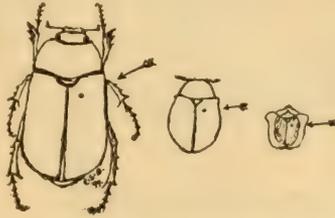


FIG. 16 Method of pinning beetles (original).

ing the elytra or wing covers and would produce very unsightly specimens. The rule for this large family is to put the pin through the right elytron or wing cover. Examples of the suborder heteroptera, or the true bug family, are usually pinned through the scutellum, the triangular piece near the base of the wings.



FIG. 17 Method of pinning true bugs (original).

Spreading apparatus. Butterflies and moths require some arrangement before they are fit for the cabinet. As taken from the bottle or papers and pinned, the wings are but partially expanded and frequently

so folded that but few of the markings can be seen. This is remedied by the spreading board, composed of two boards with a crevice between large enough to admit the body of the insect, and having below the slit a strip of cork through which the pin holding the insect is thrust. The boards and cork are held in place by end and middle pieces. The points of the pins extending through the cork should be protected by a light strip underneath. Spreading boards are made in various styles and sizes to give sufficient room for the body and ample space for the wings. Three very convenient sizes have widths of $4\frac{1}{2}$, 8 and 11 cm ($1\frac{3}{4}$, $3\frac{1}{2}$ and $4\frac{1}{2}$ in.) with body spaces for the insects of 3, 6 and 10 mm ($\frac{1}{8}$, $\frac{1}{4}$ and $\frac{3}{8}$ in.) and have a uniform length of $44\frac{1}{2}$ cm ($17\frac{1}{2}$ in.). Many prefer to have the wings spread exactly horizontal and others insist on a slight upward slant in order to counteract the natural tendency of the wings to droop after the specimens are removed from the boards.

A spreading pin is a great convenience and may be made by twisting with pliers a large beheaded insect pin tightly around and near the point of a large mourning pin in such a manner that the two form a right angle. The mourning pin is stuck into the board at a slight angle so that the smaller pin is held down on the insect's wings like a spring and prevents their flying back after being put in position. Narrow strips of paper held by pins at each end may be used in a similar manner.

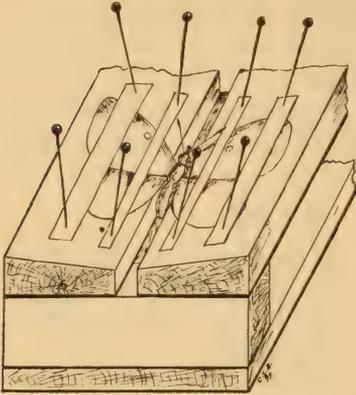


FIG. 18 Portion of a spreading board (original).

Directions for spreading. The pin is pushed through the cork till the wings are on a level with the board and the legs are arranged.

Then take a setting needle and bring the wings of one side into position, holding them there either with a spreading pin or a narrow strip of paper. In a similar manner place the wings of the other side, having the posterior margins of the fore wings as nearly as possible on the same straight line, taking special pains to have the wings of each side uniformly advanced. Secure them in place with broad strips of thin cardboard or preferably thin pieces of mica. Arrange the antennae and after the board is full put it away and allow the insects to dry for several

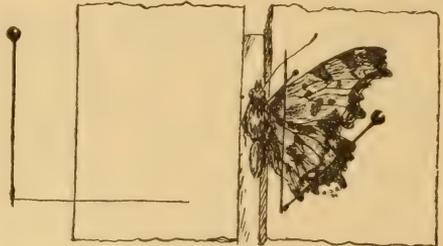


FIG. 19 Spreading pin and method of use (original).

days or a week. Another method of spreading requires still less material. The pin sustaining the insect is thrust through the pasteboard bottom of a small inverted box and squares of pasteboard or thin wood of ample size are laid on either side in such a manner as to be of the proper height. With a needle arrange the wings on the squares of pasteboard so far as possible and hold them in place by laying on small pieces of glass. By tipping up one edge of the glass considerable rearrangement is possible, or by pushing the lower block gently, wings and all may be moved either forward or backward. This method is capable of producing very good

results but the setting board is preferred by many. In spreading butterflies and moths the greatest care must be exercised not to rub off their scales. Members of the bee and wasp family, dragon flies and others are more valuable after spreading and should be so treated when possible.

Relaxing insects. From one cause or another it frequently occurs that insects become dry and brittle before they can be permanently arranged. In this condition no spreading is possible without serious breakage. If the specimens are put on paper or a piece of cork in a closed jar with moistened sand or a damp sponge and allowed to remain from a day, in the case of very small insects, to several days for the larger forms, they can be spread very well. The specimens should not be left in the jar too long or they may be spoiled by mold. A few drops of carbolic acid will aid in preventing fungus growths.

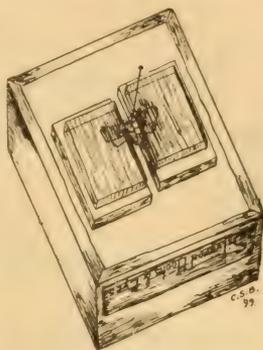


FIG. 20 Moth spread on pasteboard box (original).

Denton's tablet. A pretty way of mounting butterflies and moths, specially for display, is in Denton's tablets, which are blocks of plaster of paris with a depression for the body of the insect and with paper strips for hermetically sealing the glass covers. As the glass rests upon the wings, they are held perfectly flat and the cover affords protection from dust and museum pests. Specimens thus mounted are said to be less affected by exposure to light. The tablets are sold at a moderate price and directions are supplied with each lot.

Treatment of small insects. Many insects are too small to be mounted, even on the most slender long pins. One of the easiest ways of caring for minute specimens is to mount them on card points, which are triangular pieces of card, cut either with scissors or with a punch designed for the purpose. An insect pin is thrust through the base of the card point and the specimen attached to its extremity with a little shellac or gum. Or a fine pin may be taken, its head removed, the pin bent to a right angle, the larger end twisted with pliers tightly around a stouter pin near its point and pushed farther up on the supporting pin, and the specimen impaled on the upturned point of the smaller pin. Another way of accomplishing the same end is by cutting off the larger portion of the smaller pin and thrusting the point through a piece of cardboard or firm blotting paper, which in turn is mounted in a similar manner on a

larger pin, and is then ready for the insect. Small species can also be put with labels in gelatine capsules through one end of which a pin is run.

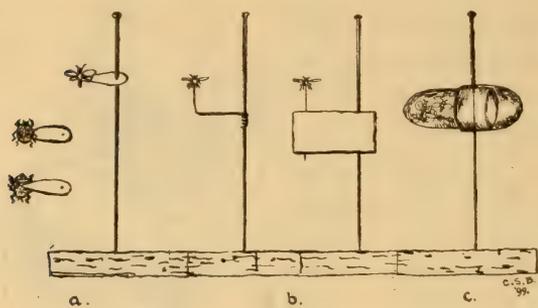


FIG. 21 Mounts for small insects. *a*, on card point; *b*, on pin point; *c*, in a gelatine capsule (original)

The collector frequently secures a large number of very small insects belonging to a single species. It would take much time to mount these as described above and yet they should not be thrown away, because such material may be desirable for later

study. They may be preserved in alcohol or placed in vials and allowed to dry before corking in order to prevent mold. In a similar manner very desirable material taken at one time may be stored under a common label till there is leisure to arrange it, as the specimens have only to be relaxed before final mounting.

Inflating larvae. The caterpillars of many butterflies and moths can be well preserved by inflation. The specimen is killed in a cyanide bottle, laid on a piece of blotting paper, pressed lightly with a pencil, and the partially protruding intestine ruptured with a needle or a pair of fine forceps. Then lay the pencil crosswise just back of the caterpillar's head and roll it lightly toward the posterior extremity. This will force out the body contents, the process being aided somewhat by removing the intestine with forceps. The rolling must be done very carefully and in many cases repeated once or twice. If undue pressure is used or the pencil allowed to slip, hairs may be lost, the skin bruised and the specimen ruined. In the posterior extremity of the empty skin insert a pointed glass tube or blowpipe, to which is attached a short rubber tube, and fasten the caterpillar skin firmly with collodion, glue or a spring clip. If the blowpipe is inserted so as to distend the posterior opening, withdrawn, heated and inserted again, the skin will usually adhere firmly to the blowpipe. Keep it distended by blowing and at the same time dry by holding it near a lamp chimney or other source of heat. The skin must be dried till rigid, but burning must be carefully avoided. Some caterpillars bear inflation very well, specially certain highly colored ones, but it is exceedingly difficult to obtain nicely inflated green larvae.

More elaborate apparatus can be employed if desired. Some use pneumatic bulbs for forcing the air into the larval skin, but human lungs permit a more delicate adjustment to needs. A lamp chimney can be placed nearly horizontally over a source of heat and serve as a drying oven, or one may be constructed of tin. The latter is by no means necessary and a busy worker will soon depend

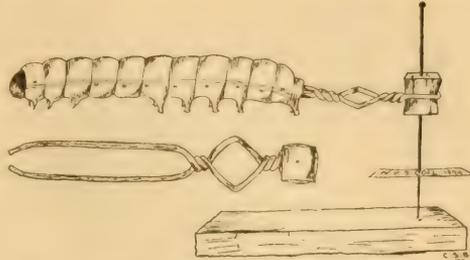


FIG. 22 Inflated larva, showing method of mounting (original).

only on a blowpipe and a convenient lamp. It is well for the beginner to secure a number of rather large common larvae and practise on them. After a caterpillar is well inflated, it must be removed carefully from the blowpipe and mounted. Though it is desirable to have larvae arranged on their food plants, many will prefer to mount them on pins. Twist a light wire round a small cube of cork and bend as represented in the accompanying figure. The two free ends are brought together and gently inserted into the body cavity, their elasticity serving to hold the inflated larva in place, and a pin is thrust through the cube of cork. Some use a straw in place of the wire, pinning through the free end. Inflating and mounting on pins permits the placing of the specimens in cases beside the adults.

Alcoholic material. Many larvae and other soft forms can not be preserved by any of the preceding methods. They should be placed in small vials in 50% alcohol for a day or two, this replaced by 65% and that in turn by 75 to 85% alcohol. If attention is paid to changing the preservative fluid many larvae will keep well. White forms, as for example grubs and some caterpillars, change color less if they are dropped for a moment in boiling water before being placed in the alcohol.

Vials and their care. The vial should be no larger than necessary to hold the specimens and may have various shapes. Ordinary straight vials, preferably with no neck, should be stored in small racks in an upright position or the alcohol will escape more or less by capillary action. As it is desirable to have all the stages of an insect together, various plans have been devised for keeping alcoholic material in cases with the adults. For trays bent necked vials are much used. In the United States national museum the ordinary round vials with bent necks

are slipped between curved wires fixed to a block, which is held firmly in the tray by forcing into the cork the two short brads in its under surface.

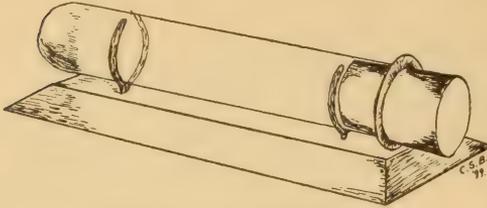


FIG. 23 Vial mounted on block (original).

This arrangement permits the storage of all forms together without much additional weight. In order to avoid distortion caused by the curved surface of an ordinary vial, Professor Comstock of Cornell uni-

versity uses a square form made with a bent neck, but the extra expense and increased weight will tend to prevent its adoption to a great extent.

Vials containing insects should be kept full of alcohol, as specimens so preserved are much less injured by jarring, and as they are always covered by the fluid, even when the vials are on their side, there is less opportunity for discoloration. Rubber stoppers are regarded as best, though first quality corks give good results. In order to have the vial full, plenty of alcohol is put in and a pin held against the upper side of the stopper as it is inserted, allows the air to escape and also the small amount of superfluous liquid.

Labeling insects. Now that considerable attention is being paid to the distribution and life history of insects, no specimen should be mounted without putting on the pin with it a label bearing at least the locality and date of its capture. This record should be intelligible to all. The name and abbreviation of both town and state should appear, for if only the town is given and the specimen sent to another state in exchange, serious confusion might result. For the same reason it is better to use an abbreviation for the month, rather than a numeral, because 5, 7/99 may mean either May 7/99 or 5 July '99, according to the custom of the reader. This label should be small, in order to economize space, and should always accompany the specimen. It costs little, is neater and



FIG. 24 Use of pin in corking vial (original).

Albany, N. Y.				
June 1899				
N. Y. S. Coll.				

FIG. 25 Locality and date labels used in state etomologist's office.

saves space to have these labels printed, leaving blanks for the day of the month and the year. If these are set solid when printed, no trimming will be necessary as the labels have only to be cut apart. When

writing labels, specially for alcoholic specimens, use india or an engrossing ink, as ordinary inks fade after a few years exposure to light. In the case of insects received from others it is well to include the name of the donor, which may either be on the same label with the locality and date or on a separate slip. When the name of the insect is known, that may be written on a larger label and put on the pin below the locality label. It is sometimes very desirable to attach other information to a specimen, but the capacity of a label is limited, and for this purpose numbers may be used. A numeral is given each insect with something worthy of note and the record entered opposite this number in a book or on a slip. In case it is desirable to make one record applying to a large number of specimens, specially if widely separated, a lot number may be given and a small label bearing it put on the pin of each. This lot number refers in a similar manner to a record book concerning the various lots of insects. For example one lot has been determined by a specialist, while another may have been taken under peculiar conditions.

Insect cases. A collector soon finds himself with a number of specimens and no place to store them. At first they may be put in cigar boxes, or even in pasteboard boxes, but museum pests find them readily in such places and rapid ruin follows unless the most vigilant care is exercised. The destructiveness of pests renders a tight case of some form a necessity. To exclude insects, light, dust and other enemies of a collection, various cases have been designed and are for sale by dealers. The essentials of a good case are that it shall be tight when closed, of a convenient size, durable and not too expensive. It must be well made or in the course of a few years warping and checking render it practically worthless. It will also be found economical to have the case lined with sheet or pressed cork to facilitate pinning specimens. The Schmidt case is very good and convenient in many respects and is extensively used in the United States national museum. It is made of white pine, shellacked or varnished, and has outside dimensions of $33 \times 21.5 \times 6.7$ cm ($13 \times 8\frac{1}{2} \times 2\frac{5}{8}$ in.). The top and bottom are cross grain veneered, the latter lined with cork, the two halves hinged at the back and held together tightly with hooks and eyes.

A good case, extensively used by Dr Lintner in his private collection, has outside dimensions of $29.2 \times 36.7 \times 6.1$ cm ($11\frac{1}{2} \times 14\frac{1}{2} \times 2\frac{1}{2}$ in.) and inside a clear space of 4.2 cm ($1\frac{3}{4}$ in.). The sides are 1.2 cm ($\frac{7}{16}$ in.) thick, of well-seasoned pine or whitewood, and are lined with tea lead, the lining extending for a short distance over the corked bottom, which is composed

of .8 cm ($\frac{5}{16}$ in.) stuff. The covering glass 27.7x35.5 cm ($10\frac{7}{8}$ x $13\frac{7}{8}$ in.) fits into a rabbet .5x.8 cm ($\frac{3}{16}$ x $\frac{5}{16}$ in.), and is held down closely on

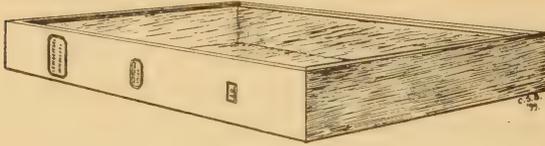


FIG. 26 Insect case much used by Dr Lintner (original).

the tea lead with glazier's triangles. The cork lining the bottom is covered with white paper and the whole outside with manila

paper. This case can be made by anyone having some skill with carpenter's tools, and if well constructed is very rarely troubled by pests, the lead apparently being obnoxious to them.

For the display of butterflies and moths, a larger case, preferably a horizontal tray, is desirable. In adopting a large drawer it is well to select a size uniform with those used in museums and to insist on the trays being interchangeable. One of the best insect cases is the form adopted by the late Dr Riley for the United States national museum. It is 45.5 cm (18 in.) square and has an outside depth of 7.6 cm (3 in.). The sides and back are .9 mm ($\frac{3}{8}$ in.) and the front of 1.6 cm ($\frac{5}{8}$ in.) stuff, while the bottom is composed of three ply cross-grained veneer in order to prevent checking. The back and side pieces are dovetailed and the bottom fitted into a groove. Inside of the outer frame is a secondary box of 3 mm ($\frac{1}{8}$ in.) whitewood, closely fitted and held 6 mm ($\frac{1}{4}$ in.) from back and sides and 9 mm ($\frac{3}{8}$ in.) from the front by blocks. The space between the two boxes is used for insecticides, usually naphthaline, and the 6 mm ($\frac{1}{4}$ in.) tongue of the cover, a frame 1.9 cm ($\frac{3}{4}$ in.) wide and 9 mm ($\frac{3}{8}$ in.) thick holding a single thick glass, fits tightly into the space between the outer and inner box. The first lot was made of California redwood with a cover frame of mahogany, but those made later are of cheaper materials; basswood or whitewood is good. These trays are made to slide on a groove. The outside of the case may be left its natural color, but the inside should be lined with white paper or painted with zinc white. Professor Comstock recommends a paint formed by dissolving one part by weight of glue in five of water, thickening to the consistency of paint with zinc white, and applying while warm.

For the Cornell university collection, Professor Comstock has adopted a case with both top and bottom composed of glass. Its outside dimensions are 40.6x48.2x7.6 cm (16x19x3 in.) and the covers are both dovetailed and mitered. The top and bottom of the case are alike, except

that the former is not quite so deep and is grooved to fit over the tongue of the latter. The bottom is covered with a series of wooden blocks 8 mm ($\frac{1}{3}$ in.) thick. 12 of his unit blocks just fill a box. There are various sizes adapted to different needs, the idea being to put all of one species on a single block, thus avoiding the necessity of repinning specimens in rearranging a case, as the blocks themselves can be moved. Where this system is used, it is found advantageous to have some of the larger blocks covered with cork.

Museum pests. In spite of great care and apparently tight cases, the enemies of an insect collection are liable to work into the boxes. As a deterrent to the entrance of insect pests, many entomologists use naphthaline in some form. Naphthaline cones mounted on pins are most convenient, but are rather costly as they retail by dealers at 75 cents a hundred, specially when naphthaline balls can be obtained for less than 10 cents a hundred. These latter can be mounted by thrusting with the aid of pliers the heated head of a pin into the ball. After it has cooled the ball will be firmly attached to the pin, which may then be stuck into the cork lining of any case.

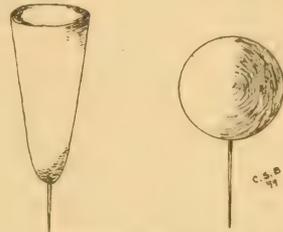


FIG. 27 Naphthaline cone and ball (original).

The presence of museum pests is revealed by the particles of comminuted matter under the injured specimen. Infested cases should be treated with carbon bisulfid, pouring in about a teaspoonful, closing the

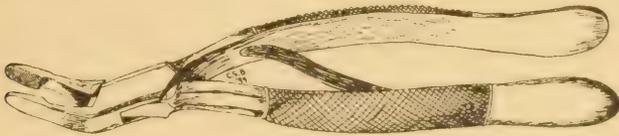


FIG. 28 Pinning forceps (original).

case and allowing it to remain from several hours to a day. This substance evaporates readily and does not injure the specimens. As its gas is inflammable and explosive great care should be exercised to prevent its vapor coming in contact with any source of fire, as a lamp, lighted cigar, etc.

Convenient accessories. When arranging insects in a case, a pair of pinning forceps will be found a great convenience. The large nickel plated dental forceps are the best, but are too expensive for many.

Some cheaper forms are sold, or a pair of ordinary pliers may be used, specially if beveled on one side by grinding. One or more small blocks covered with cork will be found exceedingly convenient for the temporary reception of pinned specimens. A small pocket lens or magnifier is another valuable aid, even in the hands of the amateur, because when

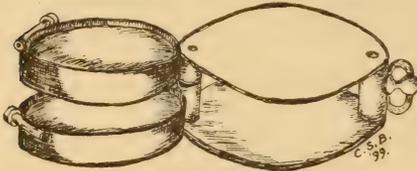


FIG. 29 Pocket lens (original).

collecting in the field or arranging specimens, there is always some form or structure worthy of examination, and if attention is paid to any of the smaller insects a lens is a necessity. Very good pocket magnifiers may be

bought at from \$.65 to \$5. One of the cheaper folding forms with two lenses will be of great service, and is in most cases the best for a beginner. Later a Coddington lens or an achromatic triplet may be purchased and employed for the more detailed examinations, but the cheap lens will also be used to a great extent.

Shipping insects. Though many insects are fragile they may be sent through the mails or by express without serious injury, by taking a few necessary precautions. Be sure the package is done up strongly. Lots of insects are received frequently in a dilapidated condition because a poor box was used. Pack insects only in very stout pasteboard boxes, or in light wooden or tin boxes. If pinned specimens are to be sent, they should be put in a small box, the pins firmly set with forceps and the box placed in a larger one, the space between the two being packed firmly with some elastic material. This latter is to lessen the jar and is effective only when not packed so tightly as to destroy its elasticity, and to be of service must be on all sides of the smaller box. Unmounted dead material can be sent safely done up in cotton batting and thin paper. First lay a little batting in the bottom and along the sides of the box, then a sheet of soft paper and put on it, separated slightly from each other, a number of insects, preferably those about the same size, cover with the same paper, lay in more cotton batting and thus fill the the box, taking care to put enough batting on top so that a slight pressure will be necessary to close the box. This will prevent the insects from shaking about and injuring each other.

Living caterpillars or other soft forms should be sent through the mails with a little of their food plant whenever practicable. There is no necessity of providing breathing holes, on the contrary larvae stand the journey better in a tight box which will not permit drying of the food

plant. For this purpose a strong tin box is the best. If more than one species is to be sent, it is well to divide the box and separate them because some caterpillars are so pugnacious that they will destroy others and a few even those of their own kind. Some aquatic larvae will bear transportation very well if packed in damp sphagnum moss, though some of the more delicate forms would have to be put in vials containing 50% alcohol. When sending packages containing liquids through the mails, the government regulations should be observed. Insects are classed as merchandise and sent at the rate of one cent an ounce. The sender's name and address should appear on the upper left hand corner of the package in order to facilitate its identification.

Dealers in entomologic supplies. For the convenience of the novice the addresses of a few dealers are given.

A. Smith & Sons, 269 Pearl st. New York, N. Y.

John Akhurst, 78 Ashland place. Brooklyn, N. Y.

M. Abbott Frazer, 93 Sudbury st. Boston, Mass.

Entomological society of Ontario, 429 Wellington st. London, Ont.

DISTRIBUTION OF INSECTS

The continued introduction of insect pests from other countries and their spread and destructiveness in this land have resulted in considerable attention being given to this important subject. While it is undoubtedly true that many insects can not be excluded from the United States, the rigid inspection at ports of entry by California agents has resulted in the stoppage and destruction of many species before they could threaten any industry by extensive ravages.

Importance. The importance of knowing the actual distribution of injurious insects has hardly occurred to many. Isothermal lines have been indicated over this country and present some interesting curves, but the temperature does not entirely control though it undoubtedly greatly influences the distribution of insects. Degrees of moisture, variations in soil and other features also have their effect. In determining the physical limitations of one species, we gain some idea of those governing others. New York state possesses a most important port of entry, many ships unloading at New York city varied cargoes from all parts of the world. The long and low-lying Hudson river valley offers a natural pathway from this port into the state for such species as find our climate congenial. A number of important insect pests have already established themselves in this valley and are spreading

over the state. As the climatic conditions limiting their existence in destructive numbers are not definitely known, it is proposed to give some attention to this important subject, at least in an incidental way, and ascertain the actual boundaries not only of the occurrence of an insect, but at what point it ceases to be a destructive pest and also any variations in the number of generations produced in different sections of the state. After several years of study of these subjects, general laws may be deduced that will be of considerable value in determining where such imported pests as the elm-leaf beetle, elm-bark louse, leopard moth, San José scale and others will be destructive. This knowledge will not only enable us to state whether an insect will be injurious in certain localities, but it may also give valuable aid in our attempts to prevent the introduction of insect pests and their subsequent spread over the state.

Life zones. A most valuable addition to our knowledge of factors governing the distribution not only of animals but also of plants, has been made by Dr Merriam and his associates in the United States department of agriculture. As a result the boundaries of certain life zones have been indicated with a considerable degree of accuracy. In New York state three life zones occur, the upper austral, the transition and the boreal. The upper austral includes the western end of Long Island, Staten Island, the Hudson river valley to near Mechanicville and an area bordering Lake Ontario and including Lakes Oneida, Cayuga, Seneca and some of the smaller bodies of water. The boreal is represented by a small area in the Catskills, a much larger one in the heart of the Adirondacks, a small one near the foot of Lake Ontario, and another of about equal size in the southwestern corner of the state. The presence of three life zones within our borders affords excellent facilities for studying the effect of climate upon insect life. It is believed that some attention to this line of work will prove not only of great scientific interest, but will also have an important practical bearing. Dr Howard is of the opinion that the imported elm-leaf beetle, the two asparagus beetles and the San José scale will be confined to the austral life zones. So far as known at present, they are thus limited in this state, though the common asparagus beetle has been taken by my assistant, Mr Banks, near Fort Ticonderoga. This means either that the asparagus beetle can exist on the border of the transition life zone or else that the upper austral extends farther up the Hudson river than at first supposed. The following are some of the native insects which Dr Howard places as austral species, that is confined to the lower and upper austral life zones: Cicada killer,

Megastizus speciosus Drury, bag worm, *Thyridopteryx ephemeraeformis* Haw, saddle back caterpillar, *Sibine stimulea* Clem., nine pronged wheel bug, *Prionidus cristatus* Linn., harlequin cabbage bug, *Murgantia histrionica* Hahn, tulip scale, *Lecanium tulipiferae* Cook, and Carolina mantis, *Stagmomantis carolina* Linn. Exact records of the occurrence of these forms are rare, and notes in regard to them and their relative abundance will be welcomed.

Imported insect pests. The formidable list of injurious insects which have invaded the United States from other countries and now cause immense annual losses, illustrate the importance of this subject. Without attempting an exhaustive compilation, the following are some of the more destructive insects. Attacking the apple, pear, cherry and peach; codling moth, *Tmetocera ocellana* Schiff., apple aphid, *Aphis mali* Fabr., apple tree bark louse, *Mytilaspis pomorum* Bouché, San José scale, *Aspidiotus perniciosus* Comst., pear midge, *Diplosis pyrivora* Riley, bark borer, *Xyleborus dispar* Fabr., pear psylla, *Psylla pyricola* Foerst, cherry aphid, *Myzus cerasi* Fabr., and the peach bark borer, *Scolytus rugulosus* Ratz. These species are well known as dangerous enemies of fruit trees.

Gypsy moth, *Porthetria dispar* Linn., elm-leaf beetle, *Galerucella luteola* Müll., and elm-bark louse, *Gossyparia ulmi* Geoff., are three bad enemies of elms. The first named does not occur in this state, though it has committed extensive ravages in eastern Massachusetts. Wheat has suffered most severely from the Hessian fly, *Cecidomyia destructor* Say, the grain aphid, *Nectarophora granaria* Kirby and from the wheat midge, *Diplosis tritici* Kirby, while clover is frequently attacked by the clover leaf weevil, *Phytonomus punctatus* Fabr., or after it has been dried, by the clover hay worm, *Pyralis costalis* Fabr. A few other imported pests may be named; asparagus beetles *Crioceris asparagi* Linn., and *C. 12-punctata* Linn., onion fly, *Phorbia ceparum* Meigen, cow horn fly *Haematobia serrata* Rob.-Desv., carpet beetle, *Anthrenus scrophulariae* Linn., larder beetle, *Dermestes lardarius* Linn., red ant, *Monomorium pharaonis* Linn. and the croton bug, *Phyllodromia germanica* Fabr.

There is hardly a person who can not recognize in the above-named insects, one or more which has caused him considerable loss, while the farmer knows many of them from sad experience. Yet these have all been introduced from abroad and some are still spreading over the country. Of the 73 injurious species regarded by Dr Howard as of first importance, each causing annual losses running into hundreds of thousands of dollars, 37 have been introduced, 30 are known to be native, while the original home of 6 is open to question. An effort is being made

by the state of Massachusetts to exterminate the gypsy moth. If the fight is given up, another pest will make its way over the land and exact a heavy tribute. It would certainly cost Massachusetts people very much less than \$200,000 annually, about what is appropriated at present, to maintain a very efficient system of inspection and treatment to prevent the introduction of insect pests. It is impossible to say beforehand just what insects may become acclimated and injurious, but were due attention given this subject, the danger of admitting such pests could be reduced to a minimum.

Manner of spread. Scale insects as is well known to many from bitter experience are readily spread by transportation of nursery stock, but not of fruit. The young are frequently carried by birds for short distances, and it has been demonstrated that winds will do the same. The English sparrow seems to be an active agent in spreading certain scale insects, for the elm-bark louse, *Gossyparia ulmi* Geoff., probably owes its general distribution over Albany and Troy to this bird. Some species like the gypsy moth which has well-developed wings but does not use them to any extent, and the white-marked tussock moth, the female of which is wingless, depend very largely upon the caterpillars crawling or being carried by some agency. The young larvae may be blown some distance by winds, but many are carried by animals, teams and other conveyances. Elm-leaf beetles are frequently seen resting on the clothing of people and there is no reason why they should not be carried by teams. In Troy, N. Y., it seems as if the electric cars were prominent factors in distributing this pest over the city. Many insects are transported in soil or rubbish accompanying their food plant. Such is probably the case with both asparagus beetles, for otherwise their occurrence here and there in the state could hardly be explained. Many winged insects fly long distances, and when this is true of the females, there is little hope of restricting their spread. The presence of well-developed wings is no proof that the insect flies great distances, though some are known to take extended flights. The monarch butterfly, *Anosia plexippus* Linn., is believed unable to stand our northern winters and the race is maintained here only by adults flying from the south. There are a number of records of butterflies being found at sea, in one instance 1000 miles from the mainland. Certain owlet moths, or Noctuidae, and the hawk moths, Sphingidae, have a strong flight and some species have been found far out at sea. Honey and bumble bees fly considerable distances and the same is true of certain beetles. In early spring it is by no means uncommon to see Colorado potato beetles flying over fields of considerable

extent in search of their food plant, yet this insect required about 15 years to make its way from Colorado to New England.

Practical application. In the case of canker worms, the white-marked tussock moth and other species with wingless females, advantage can be taken of their limited means of distribution to exclude them from trees once cleaned. This possibility warrants considerable expense in clearing them from a tree. The introduction of scale or other insects on a farm may be prevented to a great extent by studying their means of distribution and adopting proper methods to attain the desired results. It would be much safer to buy trees that have been fumigated, or even undergo the expense of fumigating purchased stock, rather than admit a pest that can be excluded by reasonable care. There are some insects which fly relatively short distances, for example the elm-leaf beetle; the parent of the apple maggot is said to have this habit, and there are probably others, but we know altogether too little regarding how far each species will fly. Those confined to relatively short aerial flights can be kept in check in one orchard with comparative ease, even though neighboring ones are badly affected, but such is not the case when the females habitually fly long distances before depositing eggs. It is only under exceptional circumstances that the length of flight can be determined for a species, but whenever an opportunity offers it should be seized. Studying the spread of insects is most fascinating field work, something that may be taken up by all and is also of great practical value, because an insect can not be controlled in the best way till its limitations in this respect are known.

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