

SOME SUGGESTIONS FOR THOSE INTERESTED IN BREEDING LEPIDOPTERA

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INTRODUCTION.—Why breed Lepidoptera? There are several good reasons.

(1) Anyone desiring a good collection of Lepidoptera will find that breeding gives him an ample supply of specimens for his collection which are in the best possible condition.

(2) In the case of species which are liable to considerable variation, a better opportunity is afforded of obtaining a good series, which will show not only the extremes of variation, but also the intermediate stages, thus making the series of far greater interest.

(3) Breeding affords an opportunity to observe, note carefully and record the various stages in the metamorphosis of a lepidopteron and to stress any peculiarities noticed. Much of interest will be noted in regard to the life histories thus obtained, and this should be entered in the "breeding records." Hitherto unrecorded information may be obtained and the sum total of scientific knowledge enhanced.

(4) Occasionally the breeder will be rewarded for his efforts by one or more unusual forms appearing in his cages as the imagines duly emerge. As an example of this, the author records that in breeding a series of *Cosmotriche pototaria* Linn., the drinker moth, a British species, he obtained a number of females whose colour was brown rather than straw coloured, as is the case in typical females.

The cause of the variation was not ascertained, unless it was due to the fact that the larvae, which had been collected in varying degrees of maturity, were subject to near asphyxiation in tin boxes on the way home and had to be resuscitated by administering fresh air in quantity to restore the larvae to health. Could this have been the reason for the unusual female forms? Experiments of a similar nature on other larvae might furnish the answer.

(5) An opportunity is afforded for experiments in the field of hybridization. With Lepidoptera this is a somewhat difficult task, and has only been successful in some cases where closely allied species were involved.

Hybrids have been recorded as resulting from the mating of *Smerinthus populi* Linn. a British species resembling very much a small specimen of our *Pachysphinx modesta* Harris, and *Smerinthus ocellatus* Linn., also a British species, resembling very closely our *Smerinthus cerisyi ophthalmicus* Bdv. The resultant moth is of an attractive appearance and may be seen in a few of the larger collections in Great Britain, chiefly those in museums.

Another example is the crossing of *Malacosoma neustria* Linn. and *Malacosoma castrensis* Linn., both British species. A figure of the resultant larva is given by South in his "Moths of the British Isles, Part I," together with brief remarks on the experiments.

A few years ago the author succeeded in crossing a male *Notolophus antequa badia* Hy. Edw. with a female *Hemerocampa pseudotsugata* Mc D. (Ent. Soc. Brit. Col., Proc. 36: 14-15. 1940.)

Enough has now been said to indicate that the breeding of Lepidoptera is in no sense a waste of time or energy, but on the contrary possesses a very real scientific and economic value apart from its being the best method of obtaining a plentiful supply of specimens for the collection; and a good collection is in itself of considerable value educationally.

We now turn to the consideration of ways and means to successful breeding. These may best be considered under three heads:

- A. Concerning ova.
- B. Concerning larvae.
- C. Concerning pupae.

A. Concerning Ova

The most valuable results will be obtained by rearing from the egg. It entails the expenditure of more trouble than breeding from the later stages, but the results from information and data of all kinds, also in most cases the large number of insects obtained, will well repay the care needed.

Ova may be obtained in several ways.

(1) They may be searched for in likely places, such as on foliage of trees and shrubs, on twigs and branches, or in the crevices of bark. Also they may be found on the cocoons of apterous females as in the case of *Notolophus antiqua badia* and *Hemerocampa pseudotsugata*. In fact few places should escape a search; the best requisites for success are keen eyesight and patience.

(2) It is sometimes possible to follow a female while she is engaged in laying her eggs, note where she settles and after her departure, collect the eggs. By this method the author has obtained ova of *Papilio eurymedon* Luc., *Polygonia oreas silemus* Edw. and *Vanessa cardui* L.

(3) By means of a virgin female.

A newly emerged female will often attract one or more of the opposite sex. This is a well known feature with certain species, such as the British *Lasiocampa quercus*, the oak eggar, and *Saturnia pavonia*, the emperor moth, females of which will attract males from a considerable distance; males will even enter houses to get to the lady of their choice. The apterous females of *Notolophus antiqua badia* and *Hemerocampa pseudotsugata* also have this power of attraction well developed. Some species of *Notodontidae*, the prominents, may be cited, for example, *Pheosia portlandia* Hy. Edw. A crippled female was placed on the trunk of a poplar; next day a male was found in attendance and in due course fertile ova were obtained and a fine series of imagines reared.

(4) By persuading captured females to oviposit. In some instances this is not at all easy. In others it is comparatively

simple. Many moths deposit their eggs freely even when confined in a match box, chip box, or any other receptacle. This is true of many of the Arctiidae, as *Arctia caja* L., some Sphingidae as *Smerinthus cerisyi ophthalmicus* Bdv., many of the Phalaenidae and Geometridae.

Butterflies are more difficult and require a large cage attractively furnished to their liking. The old fashioned meat safe is quite useful for this purpose. Air and sunshine are essential. The former must not be overlooked, as butterflies are very subject to sun stroke, if the ventilation system of the cage is bad. Glass is a dangerous substance in the construction of cages unless good ventilation is assured. Other requirements are, the presence of the food plant, some flowers to supply nourishment to the butterflies, or failing these a wad of cotton wool soaked in sugar and water or a little honey; water too should not be overlooked. This is probably best introduced by placing on the floor of the cage a layer of moss which can be well dampened from time to time. In cases where the female is disinclined to lay, it has been suggested that the introduction of one or more males might induce the recalcitrant female to commence operations.

To sum up. Conditions should be made as natural as possible and anything which suggests itself to the lepidopterist as conducive to oviposition should be included. In the above manner *Papilio zelicaon* Luc., *Polygonia satyrus* Edw. and *Vanessa cardui* to mention only a few, may be induced to lay.

Some of the more difficult hawk moths such as *Celerio gallii intermedia* Kirby, and *Celerio lineata* Fabr. will oviposit if given plenty of room and their food plant.

Telea polyphemus Cram. and *Platysamia euryalus* Bdv. will lay fairly freely in any good sized cage or container. The ova are frequently deposited on the sides of the cage or box.

Having then obtained ova, our labours begin.

Eggs should be kept reasonably cool. A porch or veranda is very suitable or failing that, a room with a northerly aspect. This is especially important in cases

where the winter months are spent in this state, as, if the ova are kept too warm, there is grave danger of the larvae hatching before the food plant is available in the spring.

Inspection should be frequent, and daily if the ova are noticed to change colour, as this often points to early hatching.

FERTILE AND INFERTILE OVA.—To determine whether ova are fertile or otherwise is not very difficult. Fertile eggs usually show a change of colour after a few days. Green eggs will turn pinkish and later perhaps become purplish or blackish, or of a leaden colour. White eggs too will frequently change to a darker hue.

Some ova are opaque. However, if there is no sign of shrinkage or distortion, the eggs are generally fertile. This applies to all ova. In some cases, where the shells are more or less transparent, the embryo larva may be seen inside and a short time before hatching the head is noticed as a dark speck.

WARNINGS.—(1) Do not attempt to hasten the hatching of the larva at this stage by introducing the food plant, but keep the ova subject to the same conditions as previously.

(2) Do not disturb a newly hatched larva until it has left the vicinity of the egg shell, as in many cases the first meal comprises this or a portion of it.

B. Concerning Larvae

Newly hatched larvae are best kept in tin boxes with glass tops such as are supplied by dealers in entomological supplies, or if we have a large number of larvae, in tins of a larger size (a "Crisco" tin is very suitable) with a piece of glass placed over the mouth to conserve moisture and prevent the escape of the inmates. The food keeps well under these conditions and therefore it is not necessary to handle the young larva so frequently. When this has to be done, a camel's hair brush should be used.

The first problem is the provision of suitable pabula. In many cases this will be known, but if it is not, it will be necessary

either to obtain the information from books, or from some other lepidopterist, or from any lists of food plants that may be at hand. Failing the above sources try by experiment to ascertain the food required. Take a roomy tin and place in it samples of as many plants, trees, or shrubs as may be deemed likely to be acceptable to the larvae. In many cases they will quickly select one or more of the plants offered and feed satisfactorily upon them. If this does not happen, further efforts must be made and other food tendered in the hope of better success. Do not let failure discourage, but persevere.

SLEEVES.—As soon as the larvae are large enough, and this must be left to the discretion of the lepidopterist, they should be placed in "sleeves" made of muslin, cheese-cloth or, if it is expected that the inmates will remain on the food plants during the winter, of some stouter material such as calico. These sleeves must be attached to the food plant in such a way as to prevent the escape of the larvae and yet be easy of access for examination from time to time. This is very necessary in order to see that no intruders such as wasps, ants, or earwigs, have gained access to the interior of the sleeves and harmed their precious contents, also to ascertain whether or not the larvae are approaching maturity, in which case it will be necessary to provide them with suitable conditions for pupation.

FLOWER POTS.—For mature larvae a 10-inch flower pot makes a very suitable and convenient larvarium. In the author's opinion it is quite as good, if not superior to, many of the more elaborate and more expensive breeding cages on the market. These latter cages however, are very useful for keeping the chrysalids of many of our butterflies. The glass fronts enable the appearance of the imago to be noticed before it has time to damage itself as frequently happens if left too long to its own devices. They are also useful for attracting by means of the virgin female.

The flower pots should be filled just over half full with earth of a suitable texture. In this a bottle should be inserted to contain water for the food plant; "Ketchup" bottles are very convenient both

as to size and shape. The bottle should be wrapped in paper to allow of its withdrawal later lest it break in frosty weather and water therefrom harm the insects at a time when they should be kept relatively dry.

When placing the food plant in the bottle care must be taken to ensure that the stems fill the mouth of the bottle; otherwise some of the larvae may find their way into the water and perish. Larvae are very prone to commit suicide in this manner unless checked. If necessary a wad of cotton wool, or any other suitable substance may be used to block the neck.

Moss should be placed over the earth, and bark should not be overlooked. This latter is essential for certain species of *Acronicta*, for example *A. alni* Linn., a British species, and doubtless for its representative in British Columbia, *A. funeralis* G. & R. which frequently though not always chooses bark in which to make its cocoon. It would also be indicated for certain species of Notodontidae of the genera *Dicentria* (*Ianassa*), *Schizura* and *Cerura*. If it is not supplied the larvae will wander and eventually die of exhaustion and fatigue.

A sleeve may be attached to the rim of the flower pot outside and tied with string or secured with a rubber band. It should be supported by a wire cylindrical frame which rests inside the pot. This sleeve forms an airy and spacious compartment and prevents the crushing and bruising of the food plant.

Generally speaking, the larvae which spend the winter months as pupae cause very little trouble. This is true also of those which pass through the stage during the spring and summer.

A plentiful and free supply of food plant is most important in order to obtain fine specimens of the imago. To put larvae on short commons results in poor and small specimens, if not in complete failure.

HIBERNATING LARVAE.—These will require more specialized treatment. They fall into two classes.

(1) Those which hibernate when mature, not feeding again but appearing on sunny

days in the spring before finally deciding to seek suitable quarters in which to pupate. To this group belong the larvae of *Isia isabella* A. & S., *Phragmatobia fuliginosa* Linn. and the British species *Macrothylacia rubi*.

These larvae, being hairy, often cause considerable trouble. They are subject to attack by fungus, and the attack is usually fatal. Preventative measures must therefore be taken. It will be noticed that these larvae take every opportunity during the early months of the year to sun themselves and in this manner to dry their long hairy coats. Therefore, sun and air would seem to be the best preventatives. Place the larvae in a large flower pot which has been filled with a generous supply of moss and stand it outdoors in a sunny position, but exposed to rain and snow. It is fatal to take these larvae indoors, for if their surroundings become dry, they will shrivel and perish. Even with the above treatment, results are likely to be disappointing.

Probably the best method for the collector to adopt is to obtain the larvae of this group on sunny days in the early months of the year and proceed as above, when the larvae will usually pupate in due course without a high rate of mortality. If however, a large number have been collected in the fall, it might be worthwhile to attempt to induce them to pupate early. Procedure as follows:

In January, bring the larvae, which have been placed in a standard breeding cage for the purpose, and which contains a copious supply of moss, into the house during a spell of cold weather and place them over a radiator, or over the fire-place in a warm room, or better still if available, over the hot pipes in a greenhouse. After a short time, possibly a few hours, they will become active and start to make their cocoons. The temperature should be between 70° and 80° F. in the cages. The moss must be kept well damped during the whole period of forcing or the larvae will dry up and die. It is of course necessary to keep the pupae in the greenhouse, or at least in a warm room, after the forcing. The rate of mortality is likely to be high, but this may be due to the

fact that many of the larvae collected have previously been parasitized. The author has not yet employed this method in British Columbia but has met with fair success in England with larvae of *Macrothylacia rubi* and *Phragmatobia fuliginosa* obtaining his imagines about February, a few weeks after pupation.

For *Isia isabella* forcing is unnecessary as the larvae will winter well in a flower pot with moss. All that appears necessary is to stand the pot in the open in a sunny position. In the spring, the larvae will reappear and eventually seek quarters in which to spin up.

(2) Those which hibernate before reaching maturity.

(a) For hairy larvae in this category belonging to the Arctiidae similar conditions as those mentioned above would be indicated.

The question of forcing does not arise, as the subject must be kept dormant till sufficient food is available in the spring. Again it must be emphasized that it is a fatal mistake to bring such larvae indoors. Plenty of moss in the containers, and the inclusion of the growing food plant, if possible, is necessary. The containers should be kept in the garden in a sunny position. In the spring they should be examined frequently to ascertain whether the larvae have resumed activity, and whenever this is apparent care must be taken to ensure that a plentiful supply of food is within their reach.

Arctia caja L. has been successfully reared in the above manner. Result of an experiment with this species follows:

Out of 423 larvae obtained from ova, 212 were placed in a large breeding cage with moss and growing plants of stinging nettle. The cage was taken into the basement of a house for the winter. Only 6 larvae survived. The remaining 211 larvae were placed in a similar container and provided with the same conditions except that in this case, the cage was placed outside only slightly protected from excess of rain. In the spring, 186 larvae reappeared and continued to feed. From these 150

pupae were obtained and a fine series of moths resulted, many of them being of the form which possesses the secondaries yellow with black spots instead of the typical red.

(b) For those which winter in a communal tent, or singly in a small hibernaculum, all that would seem necessary is to sleeve them whenever possible on their food plant. If this is not practicable, the tent or hibernaculum must be carefully removed and kept in a cool place such as a porch or outhouse until the spring, care being taken to place it amongst the food plant as soon as the shoots burst in the spring, and before the larvae return to activity.

Basilarchia lorquini burrisonii Mayn, which constructs a tiny cone-shaped hibernaculum is easily wintered in the above way, as the larva re-appears rather late in the spring, usually well after the new shoots have appeared on its food plant. Larvae of the genera *Argynnis*, *Brenthis*, *Euphydryas*, and *Melitaea* are probably best obtained in the spring, after hibernation, when they can be found either sunning themselves on banks or crawling about in the vicinity of their food plants.

Moss should always be supplied in the cages used for hibernating larvae. In support of this opinion, the author cites that while visiting the island of Capri, in the bay of Naples, during the latter part of January 1929, he observed larvae of a species of butterfly, probably of the genus *Euphydryas* or *Melitaea*, active on sunny days and nibbling freely at moss growing on stones and other places in the habitat.

(c) Geometers. Many species of the Geometridae hibernate when small, and these seem to cause no special difficulty beyond the possible necessity for a sleeve of material stouter than the cheese-cloth usually used. This is to prevent damage to the sleeve by winter conditions. Amongst others, *Campaea perlata* Gn. and *Chlorosea nevadaria* Pack. can be reared in this way. Of the latter species, out of 10 larvae obtained, six imagines resulted.

(d) Phalaenidae. These larvae, many of which hibernate, will probably cause

some trouble, and the author reports many failures in this group.

The larvae in most cases burrow into the soil and remain for long periods 'resting', as the term is; during this period they should not be disturbed. Others will creep under stones and roots, or will enter moss where they are sometimes found during gardening operations. If of a species worth keeping, they may be placed in a container with earth and moss, when they will often enter the moss and in due course, pupate. The containers, preferably flower pots, should be kept outside, slightly protected from rain. Do not bring the larvae indoors.

On no account disturb larvae which are about to change their skins or pupate.

DISEASES.—These include injuries, the stings of parasites and diarrhoea. For injuries little can be done. For the stings of ichneumons and the like, it is sometimes possible to remove the eggs, if they have not hatched, and thus save the life of the caterpillar. This may be accomplished by the use of a needle and a pair of tweezers. Great care however, is necessary or the larva may die as the result of the operation.

For diarrhoea: If this condition is caused, as frequently, by eating too succulent or too damp food, it may be relieved by supplying the older and tougher leaves of the plant, at the same time attending to the ventilating of the cages. If on the other hand, it is caused by some virus or epidemic infection, the author knows no satisfactory remedy. This applies too in the case of the fungus previously mentioned. The results in both these cases are usually fatal. Prevention therefore is indicated as the best course to adopt. This would include good ventilation, together with the admission of sunlight to the cages, clean and healthy surroundings and the removal of all substances likely to become mouldy, or centres of infection. Spraying with disinfectant should also help.

C. Concerning Pupae

Most of these present little difficulty. In general they should be kept cool and free from excessive moisture. For those

which spend the months of winter in this stage, a north aspect on a porch, or a position at least subject to the outside temperatures and the humidity of the atmosphere, is best. Disturb as little as possible and inspect from time to time. Daily inspection will be necessary as the time for the appearance of the imagines approaches.

Butterfly pupae: Those of the papilios do well if wintered in standard breeding cages. The pupae of *Polygonia*, *Vanessa*, and *Basilarchia* which pupate during the spring and summer months are also conveniently housed in this way. **CAUTION.** Do not assume that a pupa is dead and throw it away because the normal time for the appearance of the perfect insect has passed. Many species "lie over" one or more winters, especially is this true of certain Sphingidae, Notodontidae and some others.

As an example of this, *Smerinthus cerisyi ophthalmicus* Bdv., has been known to spend three winters in the pupal stage. During this year, 11 males and 4 females have emerged after the third winter. *Nadata gibbosa oregonensis* Butl. has also been reared after three winters as a pupa and *Paonias excecata* A. & S., *Pseudohazis eglanterina* Bdv., and *Acronicta hesperida* Sm. after two winters. In the case of the last named species, 5 adults were reared.

The case of *Pheosia portlandia* is interesting. This species would appear to be multibrooded under suitable climatic conditions. On the south part of Vancouver Island at least it appears to be partially double-brooded. From a single batch of ova, 32 imagines were obtained in August and September 1942, 4 in April and May 1943, one in August 1943, and one on May 4, 1944.

Careful examination of pupae seldom does harm. After examination they should be placed on moss and lightly covered with the same.

DAMPING.—This is recommended by some authorities, but it is not, in the opinion of the author, very desirable, especially in cases where the pupae have either been removed from their cocoons or dug up during gardening or by "pupa digging." The natural humidity of the atmosphere

is usually all that is necessary. Mould must never be allowed to appear in any container for pupae.

A FEW DIFFICULT SPECIES.—Some hawk moths as *Celerio lineata* and *C. gallii intermedia* frequently die in the pupal stage. To winter these therefore is difficult and Dr. H. Guard Knaggs in his valuable work "an Entomologist's Guide" recommends forcing.

The pupae are placed in a suitable receptacle on moss and lightly covered with more. This is then well damped and the container placed in a warm room, or better still over the hot pipes in a greenhouse, when the moths should shortly appear. The temperature should be about 70°F.

Some of the prominents too may be found a little difficult. It would appear that the larvae of certain species of *Dicentria (Ianassa)* and *Schizura* though making their cocoons in the fall remain "resting" during the winter months, only pupating a few weeks before the time for the appearance of the imago. Any break in the cocoon, which consists of a more or less transparent substance, seems to be fatal to the larva within. Cocoons of the species of *Cerura* must always be preserved unbroken.

PREPARATION FOR IMAGINES.—It is necessary to make some preparation for the safe arrival of imagines in perfect condition, otherwise disappointment will result through malformations.

(1) The inside of the breeding cages and containers should be somewhat rough to enable the newly emerged insects to crawl to a suitable place and dry their wings. A few twigs are helpful.

(2) When the larva has cocooned in a sleeve, it is often best to open the cocoon a week or two before the insect is expected to appear. The pupa may be left in the cocoon provided that free access to the outside world is assured, or may be removed and placed on a bed of moss. If this is not done, it is likely that the insect will be deformed or even fail to get free from the cocoon. This commonly happens with many species of *Acronicta*. It is sometimes

advisable also to open the cocoons of *Platysamia euryalus*.

CONCLUSION.—The requirements for the successful rearing of Lepidoptera may be briefly summed up as follows:

- (1) The careful observation of all matters of interest and the due recording of the same.
- (2) A plentiful use of a somewhat rare commodity often spoken of as "common sense."
- (3) An unlimited supply of patience.

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Also written works by the following:

- H. Guard Knaggs**—The Lepidopterist's Guide for the use of the Young Collector of Butterflies and Moths. Revised and enlarged edition, 1901. Gurney & Jackson.
- Richard South**—The Butterflies of the British Isles. 1906. Frederick Warne & Co. The Moths of the British Isles, Part I. 1907. Frederick Warne & Co. The Moths of the British Isles, Part II. 1908. Frederick Warne & Co.
- L. W. Newman & M. A. Leeds**—Text Book of Butterflies and Moths. 1913. Gibbs and Bamforth Ltd.

NOTE ON DALOPIUS TRISTIS AND D. INSULANUS (Coleoptera, Elateridae). Little is known of the habits of our native *Dalopius*; the following note deals with *tristis* Brown, the commonest species in the southern interior of British Columbia, and *D. insulanus* Brown from the coast.

During the last week of September, 1943, adults of *tristis* (det. W. J. Brown) were found in numbers in the duff under western larch trees two miles south of Needles, B.C. Many of the beetles were still teneral and in their pupal cells; a majority of those fully colored and hardened were males, and some of these had already left their cells. The latter were loosely constructed, unlined, and consisted of dead needles and associated forest litter held together by a few silken threads. They were placed about two inches below the top of the duff. *D. tristis* is one of the first elaterids to appear in the spring, and at Salmon Arm is common on the flowers of Rocky Mountain maple, *Acer glabrum*, in April.

Professor G. J. Spencer found *D. insulanus* (det. H. B. L.) hibernating at Vancouver, B.C., on November 3, 1942. The beetles were between boards in the back yard of his city lot, congregated in numbers up to 30 at a time. None was found on an examination of the same area in late January, 1944.—Hugh B. Leech, Vernon, B.C.