

101

INSTRUCTIONS
FOR THE
COLLECTION & PRESERVATION
OF
NEUROPTEROUS INSECTS.



BY R. M^CLACHLAN, F.L.S.

1873.

LONDON: JOHN VAN VOORST, 1, PATERNOSTER ROW, E.C.

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INSTRUCTIONS FOR THE COLLECTION AND PRESERVATION OF NEUROPTEROUS INSECTS.



The best aid and incentive to the study of any group of natural objects is the possession of a well-ordered collection, and any hints tending to further this acquisition cannot but be of service. Taking this for granted, I propose to give here general instructions to those entomologists—few though they be—who turn their attention to that heterogeneous assemblage of insects known as the Linnean order Neuroptera, believing also that some who have neglected this order for want of some general guide to the means of possessing the necessary collection, may be induced to turn their attention thereto if they learn something of the *modus operandi*. As the majority of these insects are aquatic in their earlier stages, the very excursions necessary for their collection cannot fail to be a source of enjoyment to all who can appreciate the beauties of natural scenery, for they must take the collector to the banks of rivers and lakes, reedy ponds and rushing waterfalls, localities upon the beauties of which the author of ‘Rambles by Rivers’ would have eloquently discoursed.

As the utility of all instructions depends upon their conciseness, I shall endeavour to concentrate these remarks as much as may be consistent with their usefulness, by laying down general hints, leaving the more minute particulars to be filled in by the accumulated experience of individual collectors; for, after all, experience is the only true guide,—*that* alone can help the entomologist to that correct appreciation of cause, effect, and probability, so essential to the success of the object he has in view. And though I especially address these notes to *British* entomologists, I shall embody therein more general instructions to collectors abroad, those who cannot find time for elaborate preparation of their specimens, and with whom the acquirement of large numbers of specimens and species is really of more consequence, both to themselves and to the entomologists who may benefit by their labours, than beauty of condition of a few examples. Specimens cannot be too perfect, or in too good condition; this I look upon as an axiom: yet it seems to me that the rage for

‘perfect’ specimens, so strongly marked in many entomologists of the present day, savours more of the amateur than of the student; and I confess that, for my part, I would rather have 50 species perfect enough to admit of a correct appreciation of their structure and peculiarities, than 10 so perfect that not a defect exists. I throw out this last opinion not as recommending carelessness of preparation, but as discouraging the craving for cabinet objects instead of materials for study. The student-entomologist should try to believe that “half a loaf is better than no bread,” and not despise a specimen because a joint or two of an antenna, or a leg, &c., be missing.

GENERAL OBSERVATIONS.

Before proceeding to consider the different families of Neuroptera in detail, it may be as well to give a few general hints that will apply to all.

NETS.—This subject may be dismissed in very few words. An ordinary butterfly ring-net is sufficient for almost every purpose; for colour I prefer white, and for material ordinary book-muslin, though something stronger is sometimes advisable for sweeping. The ring of the net should be of moderately large size to suit it to the capture of Dragon-flies by giving sufficient spread.

PINNING AND SETTING.—Almost all these insects should be pinned through the thorax between the anterior pair of wings, inclining the head of the pin slightly forward. As I take it to be almost useless to attempt to induce collectors of British insects to adopt other than *short* pins, I urge here only that the pin should be run through the body so far that at least one-third of an inch projects on the under side, and that the setting board be comparatively flat. By this means the legs, &c., which are most important members in the study of Neuroptera, and without which even the generic positions cannot in many cases be ascertained, are left free, and less liable to be broken off, and the wings touch the paper of the drawer or box in no part. I would earnestly beg all Neuropterists to eschew the plan adopted by many of our Lepidopterists, who so pin and set their insects, that when placed in the cabinet they look more like so many permanent rows of postage-stamps neatly gummed in an album, than collections of natural objects intended for purposes of study and hence liable to repeated removals, the legs, &c., being so hidden as to give an idea

that these are absolutely of no consequence, and that everything depends upon the pretty colours or markings of the wings. Setting-boards with *square* grooves I hold to be infinitely preferable to those with the ordinary *rounded* grooves. My own British collection is set upon short pins, but if I had to re-commence to-morrow (which Heaven forbid!), I would carefully avoid these, use longer ones, and set the wings flat, after the method adopted by almost all except British entomologists. The advantages are infinite. The insects suffer little, if at all, from mites and other depredators; and, what is of paramount importance, the notes of the locality, date, &c., can be placed in neatly written labels upon the pin itself, and every specimen may also bear a name-label, a point of much weight in typical collections; furthermore, the insect is easier to examine under the lens. But some of our continental friends carry the use of *long* pins to an excess, beyond the bounds of reason or utility. A pin of about $1\frac{1}{2}$ inch in length is quite sufficient, and it should be pushed through the insect for fully two-thirds of its length. It should be *not too fine* (a point upon which continental entomologists strongly err). Two sizes are enough for all ordinary purposes, and for my re-set foreign insects I use Nos. 2 or 3, and 16, manufactured by D. F. Tayler and Co. A strong pin renders the specimen much more durable, and I fancy the absurdly fine pins used on the continent have to some extent disgusted English entomologists with the high-setting there adopted: these can only be inserted in the cork by the use of the forceps *under* the insect, and even then we often see them bent into all sorts of zig-zags, to say nothing of the unavoidable jerking off of bodies, &c. For very minute insects it is always advisable to use short pins, such as Nos. 19 and 20, adopted by English Micro-Lepidopterists, and if the collection be otherwise set on long pins, then these short pins bearing the insects should each be stuck into a little oblong piece of white pith neatly cut with a very sharp thin knife (a razor will not do owing to its thick back), and this impaled on a long pin. The best kind of pith is that obtained from dead and dry stems of Jerusalem artichoke, which is of extreme whiteness, and does not change colour by age, the latter being an especial defect of elder-pith. In setting, the wings should be spread out with braces exactly as in butterflies and moths; but it is always desirable to leave a few of each species unset, so that on the pin they retain the natural position in repose.

Setting-boards suitable for long pins are kept in stock by many dealers in entomological apparatus, or would readily be made to order; the groove should be very deep, leaving only enough cork to hold the pin firmly, so that the legs may suffer no injury. But I am always glad to receive these insects unset. When the collector occupies himself with other orders, and catches Neuroptera simply to oblige friends, he cannot be expected to waste time in preparing insects that are useless to him. The greater part relax very readily on ordinary damp sand, or in a zinc relaxing-box: Dragon-flies are especially tractable in this respect, and, when treating on them, I shall take occasion to point out, especially to foreign collectors, that these are even better if sent home not pinned.

CARDING.—On this point I shall say little, except to discourage, to the utmost, the adoption of the system. I look upon its application to almost any order as a modern innovation, which I would fain hope is on the wane, even among those inveterate “carders,” the Coleopterists. To apply it to Neuroptera, is to render them almost absolutely useless. Nearly everything here depends upon the neuration of the wings; and this can, in most cases, only be properly traced by holding the insect to the light, the intricate veining being usually more or less pale, or even transparent. Carding can only be tolerated by the Neuropterist when applied to the preservation of minute apterous forms, such as some Psocidæ.*

PRESERVING IN ALCOHOL, &c.—As so much depends in many groups of Neuroptera upon the form of the genital organs and their secondary appendages, it is of much service if some specimens be placed in spirits of wine, or some analogous medium, so that these forms can be more reliably ascertained, and safer descriptions and drawings be made therefrom than can sometimes be had from dry specimens. But I confess to having a prejudice against collections consisting almost entirely of specimens in alcohol. The constant care necessary for their preservation is a great drawback, and can be only

* In Coleoptera, “carding” has many serious disadvantages. Important characters are present in the “cushions” of the under-side of the tarsi, in the insertion of the coxæ, and in the abdominal segments, to say nothing of the mouth-parts. Some argue that all these difficulties can be met by gumming certain individuals on the back. But suppose the specimen *ventre à soleil* be not specifically identical with those *ventre à terre*! and this is an accident likely to occur to the most expert Coleopterist. An esteemed colleague, to whom I have often argued my objections to the carding system, suggests that the specimens can easily be “floated off” in water, and examined on all points. What unnecessary trouble! what bother over gum-beelugged tarsi, &c.! I often see carded Carabi; and, if the practice be not on the wane, as I think it is, I expect to see a carded Goliath-beetle!—R. McL.

exercised in large museums, and, even in these, I think experience will prove that pinned specimens will stand a much better chance of a long existence than will those in alcohol; and this must not be lost sight of when typical collections are concerned. There is no reason why a pinned collection should not last for at least a couple of centuries, and be then of use to the student, if ordinary care be taken; but I much fear that the myriads of glass tubes with alcohol, &c., necessary for a large typical collection, would, with their contents, stand little chance of an existence for half that period. Hence, I look upon this mode of preparation as more adapted to temporary purposes. If the necessary descriptions or figures be once made, much is done, for the natural form of the parts can, in most cases, be traced in the dry insect; whereas, details drawn up from dry insects in the first instance, are often difficult of application to the actual condition as exhibited in moist preparations. Mr. Eaton strongly recommends using pure glycerine and water, the former being added drop by drop to a tube partly filled with water till it is full, and with the addition of a small drop of acetic acid, the tube being finally corked. And here I would urge my chief objection to moist preparations. If cork only be used, the spirit or other substance will quickly evaporate, and the insects be destroyed; and if hermetically sealed, the specimens are comparatively useless, for sufficient examination can seldom be made through the glass tube. Carefully prepared microscopic slides of the whole insect, or of the particular part to be examined, in Canada-balsam or glycerine, seem to me more likely to serve the purpose intended.*

BOXING, KILLING, &c.—Most small species, when caught, may be placed in ordinary pill-boxes till arriving home from a day's excursion; but if the weather be hot, many of them are liable to die, dry, and get broken in the course of a long day. This applies especially to water-frequenting groups, for these part with their moisture very readily and soon become dry (Botanists experience a similar thing in drying water-plants for the herbarium). Therefore, it is often desirable to kill the insects as soon as caught, and pin them in a zinc pocket-box with damped cork. A quantity of small glass tubes with corks is a useful adjunct to the other apparatus carried by the collector. For

* Foreign collectors often send home beetles and other hard-bodied insects in spirits. This plan should not be applied to Neuroptera, unless on the before-mentioned principle, that "half a loaf is better than no bread," or for special purposes. Those with hairy bodies or pubescent wings are much injured in spirits.—R. McL.

killing, nothing is better than a "killing bottle" (such as is now supplied by any dealer), consisting of a short, wide-mouthed pomatum-bottle, into which is placed a small quantity of cyanide of potassium, this being covered with about an inch of plaster of Paris made into a thick paste, which soon hardens, through which the deadly cyanogen gas slowly passes. Such a prepared bottle will maintain its effect for several years, and the insects die almost instantaneously without becoming stiff. In the case of insects in small pill-boxes, it is advisable to place box and all into the bottle, having first made (for more rapid effect) a small incision with the point of a penknife in each lid. Those species that have no great amount of hairy clothing may be bottled from the net, remaining in the bottle until the time arrives for setting, but hairy species rub too much one against the other if this plan be adopted for them.

In bringing these preliminary remarks to a close, I would reiterate that *experientia docet* is the best motto for the collector. I have known men who have spent the greater part of a tolerably long life in going from friend to friend asking advice, dying before they could make up their mind which particular instructions to follow. I cannot imagine a more unhappy or useless existence. Any honest advice is worthy of consideration; it is for the individual originality of the recipient to apply or modify it to his best advantage.

The few remarks on breeding that may be hereafter made, will be of necessity second-hand, my own experience on this subject not being sufficient.

SPECIAL INSTRUCTIONS.

Dragon-flies (Libellulidæ).

I commence the special portion of these 'Instructions' by a consideration of the *Libellulidæ* (using the term in its broad sense), partly because they are the most familiar Neuropterous insects, and also because this division of the subject requires to be rather more detailed than will be necessary in most of those that follow; the sequence of the groups being a matter of little consequence.

The larger species (*Libellula*, *Æschna*, *Anax*, &c.) force themselves upon one's notice by their bold and fearless flight when engaged

in 'hawking' in the bright sunshine. Some also (e.g. *Æschna grandis*) delight in the long twilight of a fine autumn evening; but it is useless to expect to see dragon-flies at large in dull weather; they may then be occasionally found at rest, and picked up with the fingers. As water-loving insects *par excellence*, the vicinity of that element is of course the most likely situation in which to seek them. But many carry on *their* collecting operations far from water, and broad heathy commons, or shady lanes (according to the species), are often enlivened by the presence of these tyrants of the insect-race. Boggy moors, treacherous to the footsteps of the too bold entomologist, and rocky mountain-sides, are peculiarly favourable localities. Never *chase* a large dragon-fly; such a proceeding is useless 'waste of tissue,' to say nothing of the chance of sinking to the middle in a bog, or coming violently to grief over herbage-hidden rocks and cavities. When one is seen frequenting a certain spot, wait till some tempting prey bring the pursuer to within reach, then, by a dexterous stroke of the net, secure it. Many species shew especial predilection for even a particular twig, and although they may make long and varied excursions, they will return again and again: so be not too precipitate, remembering that if one be struck but not captured, or sufficiently scared, it will go away at a pace defying pursuit, and not again put in an appearance. Mr. Wallace, in his 'Malay Archipelago,' relates that at one of the islands (Lombok) visited, and where large insects are used as food, the natives catch dragon-flies by means of limed twigs, the habit of haunting particular spots being no doubt taken advantage of. I have frequently, when out walking without a net, knocked down the large species with my stick, and specimens so caught often sustain little or no injury. The smaller slender-bodied species (*Agrion*, *Calopteryx*, &c.) can be captured with comparative ease, though even with them one must not rely upon obtaining a second stroke if the first miss its object. These frequent the sides of running brooks, reedy ponds (especially those formed by the 'backwaters' of rivers, which are often isolated in summer, though connected with the stream in the floods of winter), and weedy ditches. If there be a hedge-row in the vicinity, so much the better, as they will leave the margins of the pond or ditch for the sheltered side of the hedge, where they may be seen flying in swarms. Even the open expanse of a flowery meadow far from water, and the rides in woods, are often haunted

by myriads of Agrions. Scarcely anything more beautiful exists in nature than a stream over which are flying our native species of *Calopteryx*; but the sight of a forest rivulet frequented by some of the brilliant and metallic exotic species must be a treat never to be forgotten by the naturalist.

It must be borne in mind that dragon-flies are long-lived insects, and, in some cases, several days elapse after hatching before the colours are fully matured: thus the male of *Libellula depressa* only obtains its pulverulent blue colour by slow degrees; for some days it is yellow, like the female; in a collection, it is always desirable to have specimens thus comparatively immature. *Very recently developed* examples are detected by the limp consistency of all their parts, and especially by the wings, which, when the insect is feebly flying, look as if (to use the apt expression of another observer) they had been dipped in mucilage; for the sake of understanding a species in all its conditions, it is even advisable to retain some of these.

With regard to the best means of conveying the insects home when caught, I can scarcely do better than quote the words of Dr. Hagen in the 'Entom. Weekly Intelligencer,' vol. iv, p. 88. He says:—"In collecting the *Libellulæ*, I take a number of strips of "paper doubled in two, and place the wings of a caught specimen "between the folds, and with a pin at each side of the wings, fasten it "into my collecting box, without pinning the insect itself: thus, in a "small box, you may pack many in a small compass, taking care not "to put them within reach of each other's jaws." Or the insects may be killed or stupified by a sharp pinch, and then be temporarily pinned in the box through the side of the thorax, the wings being kept down by a simple paper brace pinned at each end. A more elaborate plan is that explained by M. Blisson in the 'Annales de la Soc. Ent. de France' for 1840, who recommended that the insect when caught be placed in a sort of paper shroud, covering almost the whole insect excepting the head. With the slender-bodied small species it is, I think, better to pin at once in the ordinary manner between the wings: but, in all cases, emphatically regard the instructions not to put them within reach of each other's jaws; even specimens thought to be dead may revive, and then, upon arriving home, the results of a day's labour present no better appearance than jagged wings and mutilated bodies. Though, apparently, so insensible to

pain, and tenacious of life, they are, in reality, easily killed, and Dr. Hagen even asserts that they die rapidly by simply placing the box close to a window in the hot sunshine: this I have not tried.

I now come to the most important parts of the subject: firstly, the preservation of them in collections without breakage; secondly, the preservation of the colours. On these points much has been written; and I will endeavour to combine the advice of previous writers with my own experience. The body of a dry dragon-fly is extremely liable to dislocation at any segmental division, the compound consolidated thorax being in reality the only part that will remain entire with any degree of certainty. The head is attached very slightly, yet this will often move round, almost as if on a pivot, without becoming detached: however, if it come off, it can easily be re-attached by a strong solution of shellac in spirits of wine; and some may even prefer to voluntarily behead all their specimens, and unite again with this or some similar liquid cement. Taking the smaller species (*Agrioidæ*, &c.) first, I do not recommend, with them, any system of disembowelling, believing, from experience, that the preservation of the colours is not furthered thereby. Dr. Hagen ('Intelligencer,' vol. ii, p. 82, and vol. iv, p. 88), advises that a needle with thread be introduced into the under-side of the thorax, and brought out *before* the termination of the body (mark especially, *before* the termination, so as not to injure the appendages of the apex), the thread being drawn backwards and forwards to remove some portion of the viscera, and a clean thread then inserted and cut off at each end. Baron de Selys-Longchamps, whose experience is probably greater than that of any other living entomologist in these matters, prefers ('Revue des Odonates,' p. 378) to use no endeavours to extract the viscera in the slender species. In this I agree with him, and explain here the plan I adopt. Having provided myself with some stout horse-hairs, I cut them up into short lengths; one of these lengths is inserted in the under portion of the thorax of the insect, and is gently pushed down until it reaches the extremity of the abdomen, but it is not pushed *through*, and, by this means, the anal organs can suffer no injury; the thoracic end is then cut off, and the specimen is thus rendered incapable of breakage. I conceive horsehair, when it can be obtained, to be infinitely preferable to any other substance, if only on account of its elasticity. The larger species require a more elaborate treatment, and,

as a rule, it is certainly desirable to eviscerate at least the abdominal portion of the body. To do this, take a fine-pointed pair of scissors, and cut an incision along the membranous longitudinal suture of the under surface; the inside can then be extracted with a pen-knife, and a little brush-pad of cotton wool may be used to wipe out the remaining moisture. Then fill in the interior with clean cotton wool, a small quantity will suffice; and it is better to err on the side of too little than of too much; for, in the latter case, the body assumes an unnaturally dropsical appearance when dry. I prefer *white* wool in all cases. Many elaborate plans of using differently coloured paper, made into little rolls, or coloured wools adapted to the natural colour of the body, have been proposed, and some have gone so far as to attempt to imitate the markings by designs painted on the inserted paper (!). All this I look upon as unnecessary and, to a considerable extent, more than useless, trouble. It is in vain to attempt to reproduce the natural tints by artificial means; if the eviscerating process be performed with sufficient care, some, at least, of the original beauty will remain; more than this cannot be obtained, and should not be expected. Species of medium size may be partially cleansed by means of a piece of dry grass-stem drawn backwards and forwards (after the manner before noticed when speaking of the *Agrionidæ*), and breakage prevented by a clean piece of the same stem (or some similar substance) inserted permanently: decidedly the best material is the straight wire-like vegetable substance so extensively used in making mud-brooms; this possesses almost the elasticity of horse-hair, and is stout enough for even the largest species.*

In the 'Intelligencer,' vol. ii, p. 82 (see also vol. iv, p. 87), Dr. Hagen very justly remarks that:—"If a species be sufficiently common
 "to allow of many specimens being taken, we are sure to find that some
 "of them keep their colours well without any preparation." This I can emphatically confirm: I have, *inter alia*, large British *Æschnæ* which now, after several years, have their colours and intricate markings almost as fresh as when first caught, and this without the slightest preparation. But he goes on to say:—"These are specimens which
 "had not long escaped from the pupa state, and had not yet commenced
 "their ravenous career; their empty intestinal canal containing no

* This material is known in commerce as 'Bass' or 'Piassaba.' Mr. Jackson, of the Kew Museum, informs me that it is the produce of two species of Brazilian plants—*Altelea junifera* and *Leopoldinia Prussaba*. -R. McL.

“foul matter.” The last part of this sentence is perfectly correct, for it is the decomposition of the partially-digested food (assisted in the ♀ also by the ova) that destroys the beauty of the specimens, and, at first, I accepted the explanation in all its details. Further consideration, however, induces me now to differ from him as to these specimens being recently developed. All dragon-flies take from two days to a fortnight (according to the species) to become fully mature; yet they eat in the meantime, and the individuals that do not change *are* usually fully mature. I look, therefore, to another explanation. Dr. Hagen hints that specimens taken very early in the morning are the most likely to retain their colours; this I consider not owing to the fact that they are recently developed, and have not fed at all, but that the food of the preceding day has been digested and passed away: and I should look to even more certain results in the case of specimens taken during the first incoming of fine weather after an uninterrupted series of gloomy and wet days.

I conclude the already too lengthy remarks in this chapter by a few hints to *foreign* collectors. If the specimens be pinned when caught, each should have a grass stem, or some analogous substance, run into the body as mentioned above, taking especial care that one end be *in the thorax*; otherwise it is impossible to send over a collection which shall arrive in good condition, and one large body becoming detached will play havoc with the others. But almost all can be sent in squares of paper folded into triangular envelopes, one in each: if the body then become broken, the pieces can be fitted together with certainty. They should not be placed in these envelopes *until dry*, that is, until after they have been for some time braced down as recommended for the field collecting box, otherwise the pressure alters the form, and decomposition sets in under very unfavourable conditions, so far as the colours are concerned.

Dry dragon-flies relax very easily, and need not remain upon the setting-board for anything like the time required for smaller and more delicate insects. When the bodies are broken, they can easily be reunited by using horsehair (or something stouter for large species), inserted into the dislocated portions, taking the precaution to smear the substance with the shellac cement, and the pin will also require some of this cement on the portion that will remain *in* the thorax, to keep it secure. Pins with the heads cut off, and wire, are not

desirable mediums wherewith to connect broken fragments, as they become rusty, and eventually destroy the specimen. Baron De Selys even advises that the abdomens of all dry specimens should be voluntarily detached, and then re-connected. A solution of phenic (carbolic) acid in alcohol should be applied to each specimen to destroy mites or mould, and as a future preservative. The wool used for stuffing fresh specimens should also be saturated with some of this solution.

White-Ants (Termitidæ).

Excepting in the extreme south, Europe is happily free from these pests, and I have never yet seen any species alive. Their habits are, of course, gregarious; and Mr. Bates' 'Naturalist on the Amazons' gives a general idea that will apply to any part of the world where they occur. Each species is well known to have many separate forms (soldier, worker, &c.), and all these should be obtained from one 'termitarium.' Possibly the best plan is to send home all the forms in spirits; or, if the winged examples be pinned, they should certainly not be expanded, for the following reasons. At certain seasons these shed their wings voluntarily, and this is done by these organs becoming detached at a transverse suture close to the thorax; and specimens at all times are liable to become thus dislocated, and more especially when the wings are expanded. If anything *could* induce me to relax my opposition to 'carding,' it would be in the case of winged white ants, for I know not how to keep them intact. The gravid female, with her enormously distended abdomen, must be placed in spirits.

The small allied family *Embiidæ* is rare, and the species are not numerous. It appears to be certain that the varied conditions existing in *Termes* are not found here, but of some species the larvæ only are yet known; these occur under stones in sandy districts. M. Lucas states that the winged (or perfect) form of an Algerian species was seen running up and down the stems of low herbage, without attempting to fly when taken. The wings are not deciduous, and may be expanded in the usual way.

Psocidæ.

These, for the most part minute, insects are to be met with on the trunks of trees, old palings, &c., as well as by beating the boughs over the net; and, for this latter operation, firs, larches, yews, and, in

fact, all conifers, are particularly favourable. Where a species occurs it is usually abundant, for they are more or less gregarious: a few exotic species are of comparatively large size, but very few exceed half-an-inch in expanse of wings, and the majority are very much smaller. They are often imported with merchandize in ships; some small species (I speak here of the winged genera) naturally inhabit houses and warehouses. All run with extreme rapidity, and seldom use their wings: when captured, they should be placed in small pill-boxes, or (better still) in small glass tubes. Owing to their small size, only few will satisfactorily bear a long pin sufficiently strong, and for most it is necessary (if the long-pin system be adopted) to use the oblong pieces of pith, noticed in my general observations, for the purpose of mounting them. The wings should be expanded in the usual way on small setting-boards; but in the case of very small forms, the action of pinning will open the wings sufficiently to admit of the requisite examination. Very little is yet known of them, excepting European forms, though the exotic species are certainly *very* numerous, and are much needed: some are of extreme beauty, and sometimes even furnished with semi-metallic scales as in small moths. This is possibly the *most* neglected family of that neglected order *Neuroptera*, and the known species probably scarcely represent one hundredth part of those that exist:—*verbum sap.!*

Of the apterous species (*Atropos*, *Clothilla*, &c.) it may be truly said that most entomologists need instructions as to how to get permanently rid of, rather than how to procure, them. They are everywhere, and always making themselves obnoxious by destroying the peace of mind—and the collections—of the Naturalist. One species, at least, is known to inhabit ants' nests, and many more may yet be discovered as ant-guests. Any permanent mode of preserving them as specimens is difficult. They may be carded—unsatisfactory!; mounted on mica—also unsatisfactory!; or mounted as microscopic slides—perhaps the most satisfactory. Collectors should try to get rid of the notion (still fostered by some who ought to know better) that these little pests are only larval forms of winged insects. Two species (one *Atropos*, one *Clothilla*) are common in all houses, and with them, no doubt, the larvæ of minute winged species that frequent human habitations; but the structure of these latter would detect them. It may here be well to remark, that there is a suspicion, not

yet sufficiently grounded, that some winged tree-frequenting species have apterous conditions allied to what is found in *Termes*; it is certain there are forms with imperfectly developed wings, and I think these are always females.

May-flies (Ephemeridæ).

Insects more attended to by the angler than by the entomologist, and upon which much poetry has been written on the taken-for-granted supposition that the romance of their few hours' existence is founded on fact. Possibly, however, some few live only a day or two as perfect insects; but these are exceptions. The neighbourhood of water, especially running water, is sure to produce multitudes of May-flies. The males of some large species (*Ephemera*) dance in swarms over the stream; whereas, the females are only to be found among the herbage, or taking short flights. The smaller species fly in calm weather more steadily and very slowly. Some are so abundant as to be used for manure, and even for feeding pigs (!), on Continental rivers; and we are even told of shrubs being bent down by the multitudes of an American species. Mr. Eaton has done good service by his recent Monograph of the family, but very little is yet known of extra-European forms. The sexes generally differ much in appearance, and, owing to the fact of the final moulting being performed after the winged condition has been assumed, it is thus necessary to have four distinct series of each species, as Dr. Hagen observed in the 'Entomologist's Annual' (1863, p. 6). When pinned, it is a matter of indifference as to whether they be 'set' or not; the caudal setæ are very difficult to retain entire, but this is best facilitated by pinning high, and not allowing these setæ to come in contact with the drawer or box when dry. The true forms cannot be properly retained in dry specimens, and Mr. Eaton (see p. 5) advises that all be preserved moist: altogether they are unsatisfactory insects from a collector's point of view, and none suffer so much from the attacks of the apterous *Psocidæ*.

Stone-flies (Perlidæ).

Always found in the vicinity of water, and, as a rule, running water, the more rapid the better. Mountain streams are especially favourable; and the larger species may be found among the herbage

on the banks, or more readily under the large stones (sometimes partially in the water) that lie on the edges of the burns. The species of the genus *Pteronarcys* (which is almost peculiar to North America) frequent the spray of waterfalls, and are furnished in the perfect state with external respiratory filaments, showing that their habits are even then so aquatic as to necessitate the extraction of air from water. The large species fly but little, yet are difficult to capture, owing to their rapid sliding motion when alarmed; the smaller forms (*Leuctra*, *Nemoura*, &c.) fly in calm weather slowly, but moderately high, over the water. Some species (*Nemoura*) inhabit muddy ditches containing very little water, but the majority are emphatically torrent-loving insects. All may be pinned and set out in the usual way, care being taken not to break the caudal setæ of those larger forms that possess these organs; and it is also necessary to be careful in spreading out the folded and delicate anal portion of the hind-wings: in re-setting relaxed specimens, this portion of the wing is extremely liable to get torn. The whole family has no great amount of beauty to recommend it, but many of the forms are extremely curious, and comparatively little is yet known of them, the separation of the species being very difficult; and, indeed, it is almost imperative that for this purpose some of each should be placed in spirits or glycerine. They are no doubt most numerous in northern latitudes; but the streams of tropical mountains are certain to produce them in numbers. Few are known from the Southern Hemisphere, yet there are some curious forms in Australia and New Zealand.

With this family I conclude what is termed the Pseudo-Neuropterous division, viz., those which undergo an imperfect metamorphosis.

Planipennia.

In this division are grouped all the species with complete metamorphoses, excepting the *Trichoptera*, and as the groups are not so sharply differentiated as those previously treated upon, they will be severally considered in separate paragraphs. Several of the families are not represented in Britain. All insects of this division should be pinned and set in the ordinary way. The larger species may be pinned into the collecting box when caught; the smaller can be placed in pill-boxes or glass tubes, and many may be confined in one receptacle, for they seldom damage each other, and have no scales to rub off.

Sialidæ.—The most familiar representative of this family is the abundant *Sialis lutaria* (well known to the angler), which swarms on palings, walls, trees, &c., near water in early summer, and may be picked up with the fingers; its flight is slow and steady, but sufficient examples can always be obtained without the use of a net. It is frequently mistaken for a caddis-fly. Only this genus exists in Europe; but there are other exotic genera, and some of the species of *Corydalidæ* (a genus peculiar to America) are among the largest insects known, some being nearly six inches in expanse of wings, and the males usually provided with enormously elongated mandibles, the use of which is not clearly evident,* as they are harmless insects of nocturnal habits. Another genus, *Chauliodes*, is found both in the old and new world; some of the species are very pretty, and many remarkable for the diversified structure of the antennæ of the males. All the genera are aquatic in their early stages.

Raphidiidæ (*Snake-flies*).—A small group, peculiar to temperate climates, remarkable for the greatly elongated prothorax. The larvæ live under the bark of trees, feeding upon other larvæ, &c. The perfect insects may be taken by beating the boughs over the net, and fir trees are the most favourable for this operation; they may also be occasionally found on the trunks. Their flight is probably nocturnal, for they seldom show any inclination to use their wings when captured in the day-time. Up to the present time they have only been found in Europe, Northern Asia, and Western North America.

We now come to a series of families or groups remarkable for the beautifully close network of their wings, which, however, gives them no powers of flight equal to that of the dragon-fly, and they are, for the most part, feeble insects easily captured.

Myrmeleonidæ (*Ant-lions*).—A very extensive family, tolerably well represented in Europe, but absent from Britain; furnished with *short* clubbed antennæ. The peculiar habit of the larvæ of many species, viz., that of making pit-falls in sand, wherein to entrap ants and other insects upon which they feed, is familiar to all entomologists. All appear to frequent sandy districts, and some are of very large size and great beauty. Most of them are nocturnal in their habits in the perfect

* A very interesting account of the metamorphoses and habits of *Corydalidæ* is to be found in the 'American Entomologist,' vol. i, pp. 61—62. It is there stated that one use of these enormous mandibles is to seize the female.—R. McL.

state, and are seldom seen even in localities in which the myriads of pits in the sand formed by their larvæ prove them to be abundant. Their flight is slow and feeble, and they are frequently attracted by light. In preserving them, it is often advisable to run something into the body, as recommended for Dragon-flies, for, although they are not so liable to breakage as are those insects, yet their durability is rendered much more certain if the body be strengthened by artificial means: the point of dislocation most to be feared is between the abdomen and the meta-thorax. Some 300 species are already known, but many of them are difficult to determine, or even to describe, with any degree of satisfaction, and the generic differentiation of the various groups has yet to be undertaken, all done hitherto being only preliminary.

Ascalaphidæ.—Closely allied to the Ant-lions, but distinguished by their *long* clubbed antennæ, which are like those of butterflies; and, in fact, this peculiarity, combined with the gay colours of the restricted genus *Ascalaphus* (which is peculiar to the European fauna), so far deceived some of the earlier entomologists, that—overlooking all other characters—they described them as Papilios. They frequent dry and sandy districts, but the larvæ never make pit-falls. The species of *Ascalaphus* have a habit of ‘dancing’ in the air in the bright sunshine, and their powers of flight are greater than are those of any other *Planipennia*. Most of the less gaily coloured exotic genera are nocturnal or crepuscular, and one species has been noticed hawking after insects round the branches of trees in the evening, much after the manner of Dragon-flies, retiring into the crevices of the bark during the day. All of them rest with the wings closed longitudinally and roof-shaped in repose, with the exception of one American genus, in which they are extended horizontally. With the long slender-bodied species it is best to insert something in the body. Both these and *Myrmeleonidæ* may be sent home in paper envelopes, as noticed for Dragon-flies, though it is not here so advisable; but if this be done, it is especially desirable not to place them in the envelopes until fully dry.

Nemopteridæ.—One of the most extraordinary groups, the underwings being extremely long and narrow, whereas the fore-wings are short and broad. The species are not numerous, and next to nothing

has yet been recorded concerning their habits: they are peculiar to the old world, and frequent hot and arid situations. The most handsome species are found in the South of Europe. Care must be taken not to injure the long tail-like hind-wings, which are sometimes so slender as to be reduced to mere long threads; but several of them have these wings oddly dilated immediately before the tips.

Mantispidæ.—Yet another group not found in Britain, and even feebly represented in Europe. Noticeable for the elongated prothorax (as in *Raphidia*, only that the legs are attached to the anterior instead of the posterior end), and for the remarkably constructed anterior legs, which have very long coxæ, and strongly dilated raptorial femora, the tibiæ and tarsi being much aborted. The exotic species are very numerous. The larva of the European *Mantispa styriaca* has the peculiar habit of living in the nests of spiders, feeding upon their eggs and young; and an allied genus, *Trichoscelia*, found in South America, infests the large papyrations arboreal nests of Hymenopterous insects. This clue may be of service to collectors, especially as most species seem to be rather abundant where they occur, frequenting herbage and undergrowth. Their preservation calls for no particular remark, unless it be to exercise care in dealing with the legs.

Nymphidæ.—A small (chiefly Australian) family, concerning the habits of which we have no information. The typical *Nymphes myrmeleonides* is a large handsome insect, much resembling an Ant-lion.

Osmylidæ.—Represented in Britain (and Europe) by two genera, *Osmylus* and *Sisyræ*, both aquatic in their larva-states, and frequenting rather swiftly-flowing streams. The handsome *Osmylus* is seldom seen on the wing, but may be easily brushed or beaten out of trees overhanging streams. The small *Sisyræ* are often abundant among the herbage bordering streams, and the larva of the common species has been found in the interior of the fresh-water sponge, but no doubt is not confined to this situation, as the insect is often abundant where there is no sponge. The discovery of the habits of some of the exotic genera must decide the question as to whether they really belong to this family: among these may be noticed the curious Australian genus *Psychopsis*.

Hemerobiidæ and *Chrysopidæ*. (Known as '*Aphis-lions*,' '*Golden-eyes*,' '*Lace-wings*,' and '*Stink-flies*').—Two families, which, in their larva-states, feed upon *Aphides*, often covering themselves with the empty skins of their prey. They may all be beaten out of trees, and are easily captured. Certain species affect particular kinds of trees. Fir-trees are always productive, both because they have species peculiar to them, and afford convenient shelter for others. The species of *Hemerobius* mostly sham death when in the net. The *Chrysopidæ* frequently come to gas-lamps: they are very numerous in species, and mostly of a delicate green colour, the eyes brilliantly golden or coppery when alive. Though amongst the most beautifully delicate of all insects, they are notorious for the power which some species possess of emitting an intolerably disgusting smell of ordure when handled, almost sufficient to cause the most enthusiastic entomologist to fling them away at once, and seek for means whereby to free himself from what may be likened to a concentrated essence of cesspools. Many of them, however, are perfectly inodorous. Some few (e. g., *Chrysopa vulgaris*) corrode the pins very rapidly, and become almost destroyed in the course of a few years. *C. vulgaris* hibernates, and, in winter, assumes a reddish colour. Their cocoons, like small white peas, may be found on the plants where the larvæ have been assisting the horticulturist, and it is a matter of no little astonishment to the uninitiated to observe so large an insect emerge from so tiny a cocoon. Re-set specimens should remain upon the setting boards for a considerable time, much longer than is requisite for the powerful dragon-flies; and care should be taken in relaxing not to allow the water to actually reach the wings, or these members become matted together, and are sure to get torn in endeavours to spread them out.

Coniopterygidæ.—Minute insects, wholly covered with a white, waxy, pulverulent secretion, and which may be beaten from trees, especially firs. Their treatment should be precisely similar to that adopted for winged *Psocidæ*. Some are so small that it is almost impossible to spread the wings, unless the manipulator has already had experience as a Micro-Lepidopterist.

Panorpidæ (*Scorpion-flies*, &c.).—Common amongst herbage, and easily captured on the wing, or swept up with the net. The males of *Panorpa* have the peculiar forcipate dilated terminal segment from

which their vulgar name is derived. In setting, some of these males should have the three terminal segments forcibly extended until dry, as otherwise they are curved over the back, and not so easy to examine,—an important point, taken into consideration with the fact that the specific characters mostly lie in these segments. They are highly predacious, feeding upon other insects, and can inflict a momentarily painful wound in the fingers by means of their mandibulate rostrum. *Bittacus* (not represented in Britain) is extremely like a *Tipula*, only with four wings instead of two, and this disguise probably has a purpose, for, in the case of a recently discovered apterous species, it was found that semi-apterous *Tipulidæ* existed in the same locality; they may thus be likened to wolves in sheep's clothing. The legs are of extraordinary length, and, in setting, must be arranged one by one with pins, otherwise they become entangled and easily break. *Boreus* is a genus of small and virtually apterous insects, found only in winter amongst moss, &c., and even sometimes on the surface of the snow. They mostly fall in the way of the Coleopterist when hunting for moss-frequenting beetles, and are no doubt often cast aside as *Acari*, or similar 'rubbish.' Though I cannot explain by what means they jump, it is nevertheless certain that they possess some amount of saltatory powers. The specific characters exist chiefly in the ventral segments of the males, a sufficient reason why they should not be 'carded;' simple pinning is sufficient, or, if time is no object, the legs may be neatly spread out with small pins.

The *Panorpidæ* are aberrant *Planipennia*, and by some are thought to form a passage to the next division.

Trichoptera ("Caddis-flies").

In no group of insects have I acquired so much practical knowledge of the habits and private lives, as in the *Trichoptera*. Although my attention has been gradually directed to the order *Neuroptera* as a whole, yet the Caddis-flies were my earliest favourites, and still constitute my pet division of the order. The days and hours spent in the pursuit of our native species have been—I can safely say—the happiest moments of my life, and I still look back with unalloyed gratification to the year 1859, when, as an enthusiastic pupil of Dr. Hagen, I commenced to collect and study them. Would that I had more companions in the field!

Wherever there is fresh water, either standing or running (so long as it be not habitually dried up by the heat of summer, or poisoned by the refuse of mines and factories, or the sewage of large cities), there caddis-flies will be found. But the immediate vicinity of water is not absolutely necessary, for many of the more powerfully organised species evidently take long nocturnal flights, and are often dislodged during the day in localities very far from water. I remember once finding numbers of a species of *Limnophilus* in a sheltered hollow on the summit of a bare chalk-cliff, where there was no fresh-water for two or three miles. I have several times before had occasion to refer to fir-trees as particularly productive to the Neuropterist; to the collector of *Trichoptera* they are pre-eminently favourable. The best way is to beat the branches over the net, and the caddis-flies that tumble into it must be boxed or bottled speedily, for they are wonderfully nimble, and by their peculiar zig-zag motions, often escape; and this habit renders their pursuit when on the wing somewhat perplexing, for although they do not fly far when disturbed, they often baffle the collector, and are even difficult to detect when settled, though probably under one's very nose. Some species (e. g., *Colpotauius*) may be "trodden out" from the herbage on the margins of ponds, and the longer the same spot is disturbed, the more abundant the insects become. Another good plan is to separate the reeds or flags with the hand, and examine closely near the roots or at the surface of the water, for this is the favourite diurnal hiding-place of many. The copings of bridges and walls should not be neglected. I have, on more than one occasion, found good species under the coping of the bridge over the Serpentine in Hyde Park. Some species of the beautiful long-horned *Leptoceridæ* fly briskly in the hot sunshine close to the water in calm weather; but, if an air of wind disturb the surface, or the sun become obscured for a moment by a passing cloud, they mount rapidly into the air and disappear. Some again (species of *Hydropsyche* for instance) dance in swarms over streams, especially towards dusk. Although (with only one or two exceptions) they are all aquatic in their earlier stages, yet their habits are as varied as are those of the terrestrial *Lepidoptera*. Many genera can only exist as larvæ in water that is always in a placid condition (such as that of ponds), whereas others require the element to be highly aërated (e. g., *Rhyacophila*) and constantly cold, and there are lovers of every inter-

mediate state, so that a few miles walk along the banks of a small stream sufficiently varied in its character, will furnish a large number of species. Even the mechanical contrivances by which man alters the natural state of a stream for his own benefit are of use to the collector, for if the placid course of a slowly flowing stream be changed to a foaming waterfall by a weir or water-wheel, the congenial conditions are at once seized upon by species which otherwise might be sought in vain. In fact, it is probable that more species frequent running than standing water, and it is this that makes the torrents of alpine regions so particularly productive; the cold is no hindrance, they may be found up to the snow-limit, and delighting in the vicinity of a glacier. So marked is the necessity of certain aquatic conditions for the well-being of particular genera or species, that the water-system of a particular district or country can often be understood by an inspection of a collection of caddis-flies from it. Thus, I once examined a large collection of species from Holland, which told as plainly of a low-lying flat country without mountains or torrents as could the most elaborate map. A certain amount of shelter in the perfect state is absolutely necessary to *Trichoptera*, and for this reason streams flowing over barren rocks are not productive. The acme of success may be obtained when the stream is fringed with low overhanging bushes; the net should be placed as far under the bush as possible, and the latter beaten vigorously over it, taking care that the net itself do not come off its handle, or it may go sailing away down the stream at a rate anything but agreeable to the astonished collector: such a *contretemps* has more than once happened to the writer. In moorland districts there are often streams which have cut their way through the peat, fringed with heather and other herbage; these are localities that should never be neglected. Light powerfully attracts some species, and unique or rare forms have more than once been found on gas lamps in the suburbs of London. It has also been recommended to hang a white sheet near water, the insects being attracted by it after dark, and settling on it. Tree trunks and walls near water should always be examined; on such positions the minute and excessively rapid species of *Hydroptilidæ* often absolutely swarm. But *experience*—that “hardest of all schools,” as I have seen it termed—is the one thing to be gained and acted upon.

Trichoptera should be set exactly as are *Lepidoptera* (premising

that the excessively low setting mentioned at the beginning of this paper be eschewed), but must remain upon the setting boards longer than is necessary for insects of the latter order. Relaxed and re-set specimens take an especially long time before it is certain that the wings will not ultimately fall back. Much care should be exercised in re-setting with regard to the management of the hind-wings, which are very troublesome and liable to get torn; occasionally a specimen will remain so long in the damping box that it falls to pieces, and yet these wings will not sufficiently relax the muscles at the point of attachment to the metathorax. If a specimen be quite intractable, then all one can do is to so far expand the wings by means of pins that an examination of the apex of the abdomen is possible.

No collection of *Trichoptera* can be considered complete without the cases manufactured by the larvæ of the various species. These are marvellous, alike from the beauty and variety of form exhibited in them, as from the great ingenuity displayed in their fabrication. The larvæ or pupæ should be extracted, and the cases may then be pinned, or gummed neatly on card. Cases made out of all sorts of fanciful materials may be obtained by forcing larvæ confined in aquaria to use such materials in default of being able to find anything else; but such cases should be looked upon in the light of curiosities only; there is always sufficient variety in natural conditions to satisfy the most fastidious collector.

CONCLUSION.

My purpose will be served, if the foregoing sketch of the ways and means best adapted to the acquirement of a collection of *Neuroptera* induces some of our young entomologists, who are tired of forming part of the crowd that can see no beauty in any insects other than *Lepidoptera*, to strike out a path for themselves, by bestowing a favourable glance upon my favourite order. It will be doubly served if they become not only *collectors* but *students* of that order. The field is enormous, and the land almost untilled: the settler in it may have (speaking metaphorically) to hew his own timber and build his own hut, but the result will be an abundant harvest.

Notes concerning the breeding of the various families from the egg, or larva, must be deferred to another opportunity.

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