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(Butterworth, Kay and MacNulty, 1966) would seem to be ideally suited for this.

Bark beetle larvae will usually feed up very well if placed in a thin plastic box which has been packed with bark and then filled with the loose powdery material usually found under loose bark. An alternative method is to remove the bark, disturbing the larvae or beetles as little as possible, and cover its inside smoothly with a piece of thin pliable plastic or plastic wrapping paper. Except when observing the beetles or larvae, keep the plastic covered bark in an airtight tin, with a small piece of wet cotton wool to keep humidity up, and a couple of crystals of thymol to prevent fungal attack.

Whenever a beetle is found under bark or in timber, note should be made of the species of wood and of the pattern or regularity of the tunnel system.

I should like to thank Fredk Warne and Co. for permission to use the illustrations of tunnels from *Beetles of the British Isles* by E. F. Linssen. These were redrawn for this article by Mr Jonathan Cooter (3290).

(To be continued)

B. J. MacNulty (4528)

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INTRODUCTION TO CRANEFLIES

Craneflies are a familiar group to most entomologists, yet one which is generally neglected. Even the layman shows recognition by giving the friendly name 'daddy long legs', though they are generally far from welcome when they come to light in our homes in the autumn. To the gardener and the farmer the larvae of some species have achieved unfortunate fame as pests and are given their own name of leather-jackets. Certainly a few of the larger Craneflies are familiar, yet it comes as a surprise to most entomologists that there are over 300 species in Britain.

As a group for the entomologist to study they have many advantages. They are mostly large and are easily obtained. Unlike many insects they will fly almost regardless of weather and time of day and

will also come to moth traps. They are no more difficult to identify than most other groups of insects and much easier, for instance, than many groups of Diptera (Hoverflies may be more attractive, but many of the genera are difficult). Perhaps one of the greatest advantages of studying Craneflies is that there is so much to find out about them, and there is scope for even the beginner to make useful observations.

What are Craneflies?

Craneflies are among the most primitive two-winged flies of the order Diptera. They belong to the sub-order Nematocera which contains many familiar flies of similar build, like mosquitoes and gnats. The majority of these related groups, incidentally, are particularly difficult to identify and consist mainly of small species. The distinction of Nematocera is the presence of long antennae consisting of more than three antennal segments and usually of thirteen to sixteen in Craneflies.

The term Craneflies is rather artificial since it includes four separate families of Nematocera. These are the Tipulidae, Trichoceridae, Anisopodidae and Ptychopteridae. Except for Anisopodidae, the Craneflies are of 'daddy long legs build', but it should be noted that there are many small species as well as large ones, the smallest having wings only 2.5mm long. Most species (302) belong to the Craneflies proper, Tipulids (family Tipulidae); the other families have only a few species. Trichocerids, the Winter Gnats, include some of the familiar dancing swarms of gnats seen on milder winter days. Anisopodids are small insects of a more compact build and with short legs. Ptychopterids are not closely related, but look very like true Craneflies; they are medium-sized blackish species found by water.

Why study Craneflies?

If one studies a popular group, such as Lepidoptera, it is difficult to make original contributions to knowledge. Diptera offer endless scope for the entomologist to make observations and records which increase our understanding. As with so many insect groups the beginner soon stumbles on endless difficulties, especially since there are no fully illustrated books of reference. Diptera constitute a quarter of the British insect fauna, a bit much to cope with at once.

Craneflies are the subject of a national recording scheme (as with butterflies and larger moths), so that records and observations are particularly needed. They are chosen because they are one of the less difficult groups to identify and are especially good for ecological studies. Perhaps most critical to the beginner, help is available in identifying material.

Collecting Craneflies

Craneflies are generally rather slow flying insects so they are easy to catch. An ordinary butterfly net will do. The one I have used for a number of years consists of a collapsible fisherman's landing net frame with a home-made bag consisting of tough fine netting bought as remnants of net curtaining and a rim of tough material such as calico.

One needs a fairly durable bag since one of the best ways of collecting crane-flies is to sweep vegetation. One soon learns to avoid brambles but inevitably one catches on the occasional unexpected snag. Proper sweep nets consist of close weave material, but this is no good for Diptera since one can only see what one has caught by looking into the mouth of the bag, and all the Diptera rapidly fly out. In a netting bag one can see something of what one has caught even with the mouth of the bag sealed. The trick is to turn the base of the net bag towards the sun, and with luck all the Diptera will fly towards the end of the bag whilst you are looking in through the mouth. With a net of this sort, at a moment's notice one is also prepared for making aim at the faster flying crane-flies which need netting individually.

Crane-flies may be removed from the net by tubing each one individually, but this is a slow process which risks loss of other crane-flies from the net and demands a large cumbersome supply of glass tubes. A killing bottle may be used, as with Lepidoptera, providing care is taken that the wings do not get wet and crumpled (a layer of cotton wool is placed at the bottom of a corked bottle or tube and a few drops of ethyl acetate are poured onto the cotton wool). Some big species do require individual treatment, but for most species a pooter (aspirator) is a very quick way of retaining a representative sample of crane-flies. It is surprisingly simple to 'poot' these insects even though they look totally unsuited to go through the small entry tube. Relatively little damage is done to these fragile-looking flies, as long as they are not overcrowded. The flies are removed by gently sucking in ethyl acetate fumes (just above the surface of the fluid or killing bottle, but do not get the liquid into the pooter), and stop as soon as it is judged that some fumes have entered; and certainly stop if fumes enter your mouth (ethyl acetate is relatively harmless, though if inhaled too much one would eventually become unconscious. Do not use cyanide!). When the flies are unconscious transfer them to a corked tube, putting in a piece of paper (to absorb condensation) with a note of where they were taken. Dab a bit of ethyl acetate on the cork (e.g. by turning a small ethyl acetate bottle upside down with the cork over the mouth) and this will be sufficient to kill the flies. Ethyl acetate relaxes the insects, and they will keep left in the tube providing they do not sweat as a result of the tube getting warm. It is best to keep the tubes in a cardboard box, or a tin with paper packing, so there is some insulation. If Crane-flies are individually tubed, they may be treated in the same way by dabbing ethyl acetate on the cork. If wished they can be taken home alive, providing they are not big ones thrashing about in a tube, but remember to put a small piece of paper in the tube, to absorb condensation, preferably addressed to the curved side of the tube so the insect does not damage itself.

The bigger Crane-flies can be pinned with ordinary butterfly pins, but the smaller species would require micro pins and staging on

polyporus strips. The smaller species are best pinned through the side of the thorax. They may be set like butterflies, but the long legs are very brittle and when spread out take up a lot of room. A cheap, neat method of mounting crane-flies, which also provides some protection for the legs, is to glue them by the side of the thorax onto card. The British Museum finds point mounting best, carried out as follows. So the insect does not splay out in all directions, let it dry flat in an envelope; if you use the semi-transparent ones designed for photographic negatives, you can see how the legs are arranged and can manoeuvre them into the position required (all hunched up or all splayed out downwards below the thorax). The insect can be put in with both wings over the back (like a butterfly with its wings closed). Cut up some card into triangles with sides a bit longer than the legs and put a pin through one side. When the Crane-fly has dried, lay it on a piece of paper; push the pin through the card until its head is flush with the card, turn upside down, and place a small blob of glue (e.g. balsam cement) on the tip of the triangle furthest from the pin. Bring the glued point down onto the thorax of the Crane-fly, the legs orientated towards the pin. Lift up with fly adhering to the underside of the point, invert so the fly is on top of the card and push the card part way back down the pin. One **must** keep note of where the insects were found, so a data label must be put on the pin giving at least date, locality and county.

Where to look for Crane-flies

Crane-flies can be found almost anywhere at all seasons of the year and on most types of ground: some species can be found right through the winter during mild spells. The best places are marshy woods but over 300 species of Crane-fly cannot all live in one place. To find a wide range of species one may look in open grass spots, open marshes, stream and river sides, bogs, dry woods, hedgerows, coastal cliffs, salt marshes; some species will be found in gardens even within cities. The main peak of emergence is in late May and early June, but there is a succession of species through the year, July and October being especially good. The Winter Gnats are, as their name suggests, out mainly between October and March.

There is thus endless scope. If one collects in a good locality for several years some 70 or more species may be found and one locality in Surrey has yielded 110 species. My record for a single day, in Wales, is 80 species, but that was by searching several very good localities in the peak emergence of early June. Working a reasonably favourable district should yield 150 species, half the British fauna.

Crane-flies may be found by disturbing or sweeping vegetation to make them fly out if they are not already conspicuous. Many species of Crane-fly do not like hot sunny conditions, so most tend to be found under the shade of trees. Some species specialise in camouflage and will be found on tree trunks. Other species live in dead wood or fungi so it is worth looking in such situations. In the evening some species will be

found swarming, the males flying in a dancing up-and-down manner as a group, usually under the bough of a tree. Moth traps and other lights often attract Craneflies.

Recording Craneflies

We have considered how to catch and mount Craneflies and now know where to look for them. We have the basis for collecting Craneflies, but will this achieve anything more than having a box of insects on pins? If we record even a few facts about where the Craneflies were taken, what sort of situation they were in, and any observations on behaviour, we may be able to contribute new knowledge.

The minimum information for a data label as mentioned earlier is date, locality and county, e.g. 12th June 1970, Godstone, Surrey (date is usually given in the form 12.VI.1970, with roman numerals for months). One may identify a species, but already have it represented in your collection: perhaps you would consider throwing it away, if you are absolutely sure of your identification, entering the information in a notebook or diary. Supposing you have built up a number of records from different places and perhaps compared them with someone else's records as well, what significance has your record from Godstone? Very little since one knows nothing of where it lives; it may have been chalk grassland, beech woods, alder marsh, lake side, etc. If one has recorded habitat, one is now in a much stronger position since it is possible to compare the various records. This may show that a species is only found in alder marshes in one district but another habitat may be preferred in another district. As such information builds up one may be able to interpret the significance of distribution patterns. Dates of flight activity can also differ from area to area, and this again may have significance.

Let us consider a record where we have given some meaningful information by saying heathland. One can provide valuable data by dividing heathland into dry heath, pine woods, birch woods, bog, wet swallow wood, pond side, etc. By knowing what type of habitat a species likes on one heathland, one may perhaps see the reason for its absence at another.

Life cycle of Craneflies

For present purposes most attention is being paid to the adult Craneflies. There is still a great deal to learn about the early stages.

As with most higher insect orders, there is a complete metamorphosis from egg, larva, pupa to adult. The eggs are small, seed-like objects which are usually inserted into the ground or other medium by the pointed ovipositor of the female (in some the whole abdomen is inserted into the soil) whilst others simply broadcast their eggs whilst flying. The larva is a cylindrical leatherjacket shape, with a small head and, in most Tipulids, two spiracles at the hind end which are encircled by a cluster of protuberances. In some there is considerable specialisation, especially in aquatic larvae. Ptychopterids have the hind spiracles

placed on the end of a long telescopic tail so that they can breath air from the surface whilst submerged in mud. The pupae generally have two 'horns' (breathing tubes) on their head.

The place to find the early stages is usually in the soil, especially damp woodland soil. Some species are found in dead wood, fungi, moss, wet leaves, dung, seepages on trees, around certain plant roots, compost heaps, wet mud, etc. They are often surprisingly difficult to find and the species vary according to the season. The early stages are easy to rear. Simply place them in a container with some of the medium in which they were found, making sure soil, etc., is kept moist, and leave enough room for the adults to emerge. Larvae can be preserved by killing in water which is nearly boiling and then stored in tubes of alcohol (methylated spirits can be used but is not so good). If you have several similar larvae from the same habitat it is as well to preserve one (or more) and rear the rest. Empty pupae should be staged with the adult.

Behaviour

In the adults very little is known about behaviour. Egg laying has been observed in only a few species; 'pricking behaviour' (just poking the ovipositor into soil) is often not egg laying. An interesting type of study is the relationship between the shape of the ovipositor and the behaviour of the egg-laying female (functional morphology). Some Craneflies have characteristic ways of flying or resting, in the latter case with wings spread or closed. When a Cranefly is seen in a collection it is at its worst; its true character can only be seen when alive. The colour of the legs and wings may be a careful adaptation to camouflage the species in the places the fly normally chooses to rest, for example many of those species which sit on tree trunks have mottled wings and banded legs. Other species, though harmless, may exhibit the warning colours of wasps and ichneumons, this being a form of protection by mimicry. Some species are apparently more active at night, when some carry out their egg laying, but little is known of nocturnal behaviour. The place where an adult is found, and its behaviour, may lead one to locate the place where the larvae live. For a species to survive, the habitat must provide the correct conditions for the larvae (often very small areas in soil where larvae may be abundant) and conditions on the surface (vegetation, etc.) must also suit the adult. As with moths, Craneflies often have certain times of day when they prefer to emerge from the pupae, but virtually no information of this sort is known. One of the best ways to find out where the early stages live is to search for empty pupal cases sticking out of the ground (or moss, etc.) when one is lucky enough to find newly-emerged adults still too feeble to fly (the wings and outer skin take a time to harden before flight is possible). Some species have, on rare occasions, been found feeding at flowers; it is strange that the habit is so rarely seen since nectar gives the fly energy which will help its survival: valuable observations can be made on this topic, noting plant species, time of day and weather conditions. However

some species are very short lived as adults, lasting less than a day. These are but a hint at the many aspects of behaviour of which we know little and where many useful studies may be made by anyone prepared to take an interest in Craneflies.

Further study

Before attempting to identify Craneflies, it will be useful to consider briefly some aspects of the further study of Craneflies. As with most insect groups, and increasingly even with moths, a microscope is invaluable for observing the diagnostic features which separate species. It is the purpose of this paper to enable progress to be made with a magnifying glass, and indeed this is all that is necessary for recognising many species. However, if there is opportunity to use a binocular stereoscopic microscope (which gives 3D vision) do so (at school, the biology master should be able to help). A microscope only becomes essential when looking at the genitalia (sexual parts at the tip of the abdomen) of some of the smaller species; for this purpose a slide mount under a monocular microscope can be used. The latter microscopes are more easy to come by, there being plenty of cheap ones on the market. Unfortunately stereoscopic microscopes are expensive but it is sometimes possible to buy them second-hand.

The best general introduction to Diptera is by Colyer and Hammond (1968). A chapter is given to Craneflies and includes some excellent illustrations by Mr Hammond. The introductory chapter concerning the structure and biology of Diptera is also well worth reading.

The main reference work for Craneflies is by Coe, Freeman and Mattingly (1950) which enables identification of all the British species known when it was published. It is unfortunately out of print but efforts are being made to republish with the addition of the further species now recognised as occurring in Britain.

A very useful work is that of Edwards (1938), which is particularly valuable for its photographs of wings. As with any reference work, a local library can arrange the loan of a copy through the national lending libraries service.

For the early stages of Craneflies, and details of how to preserve them, etc., two papers by Brindle (1960, 1967) form the standard works. Note that care is needed in identifying species since there are many whose larvae and pupae are unknown.

Some of the Cranefly names have been changed since these works were published. Reference may be made to a paper by Hutson and Vane-Wright (1969) for corrections.

If you are taking up the study of Craneflies your help with the national recording scheme will be welcome. Details of the scheme, including further information on how to collect and record, are available from me, one of the organisers, at Foxhold House, Thornford Road, Crookham Common, Newbury, Berkshire. A list can also be supplied giving all the name corrections and characters for newly recognised

species. Assistance is available with identifications. Initially it may be best to send representative material unmounted in envelopes (as previously described) since these should not get damaged in the post if properly packed in a small box or tin. Don't forget to write the locality data on the envelope. The name will be added and on their return, the sender can mount the specimens for his reference collection. If the grid reference can be determined from maps, this information should be given. Mounted material may be sent through the post, but legs may fall off. If you are able to deliver and receive mounted material in London this can be relayed through the Diptera Section in the Department of Entomology at the British Museum (Natural History), South Kensington, where Tony Hutson and Dick Vane-Wright are the other co-organisers of the recording scheme.

It helps considerably to gain access to a collection against which to compare one's specimens and it is also invaluable to have access to an entomological library. These needs can be achieved by joining a society which provides facilities and where it is possible to meet other entomologists. The British Entomological and Natural History Society at its London headquarters has an extensive library and is building up a reference collection of Craneflies. A number of local natural history societies have entomological books and may be able to advise on where collections are available. Unfortunately collections are few and far between, though several museums have Craneflies. Take care to ask whether the names are reliable since many of the collections are full of errors. It is hoped to eventually revise the names in all museum collections. The main provincial collections are at the National Museum of Wales in Cardiff, Manchester University Museum, the Royal Scottish Museum in Edinburgh and Dublin Museum.

In addition to Mr Brindle at Manchester University Museum, other Museums with staff at present known to have a personal interest in the recording scheme are at Belfast (Roger Nash) and Liverpool (E. G. Hancock). There is a good local collection at Malham Tarn Field Centre (Field Studies Council). Collections needing revision include those at Dorchester Museum, Birmingham Municipal Museum and Leicester Museum (the latter is under revision). The organisers of the recording scheme will be glad to hear of any collections needing attention.

Alan E. Stubbs

(This paper will be continued: the next part will give help in identifying the commoner species of Craneflies.)

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A PRELIMINARY SURVEY OF THE FOOD AND FEEDING HABITS OF ADULT BUTTERFLIES (Continued)

Feeding behaviour

Lepidoptera behave in different ways when feeding which can be roughly graded as follows:

- In flight, without settling at all, which is well exemplified by those insects usually too heavy to rest on a flower, e.g. the Sphingidae, in particular *Herse convolvuli* Linn., *Macroglossum stellatarum* Linn. as well as certain Noctuids such as *Heliothis*, but not by butterflies except the big 'Birdwings' (Papilionidae).
- Settling very briefly with rapidly vibrating wings which is typical of *Plusia gamma* Linn.
- Settling but with intermittent wing-fluttering, a characteristic of various *Papilio*.
- Settling very briefly and passing rapidly from flower to flower, again exhibited by various *Papilio*.
- Settling to feed with widely spread wings, occasionally fanning but in no particular hurry to pass on, e.g. various Nymphalids such as *Vanessa atalanta* Linn. and *Aglais urticae* Linn.
- Those which feed with wings tightly closed such as the Pierids *Gonepteryx rhamni* Linn. and *Colias crocea* Geoff. Some Pierids however, e.g. *Pieris rapae* Linn. and its near relatives, feed with wings slightly open.

Behaviour of young adults

The males of many butterflies emerge from the pupa before the females, sometimes by as much as a week, and the general opinion is that the latter stand a better chance of being found and fertilised than if both sexes emerged together. The behaviour of these young males is quite distinct and much of their time is spent in feeding and investigating anything which resembles a female of their species. Butterflies seen at mud puddles are almost always freshly emerged males and although we do not see the vast congregations of insects at wet mud and sand as in

the tropics, the phenomenon is not unknown in Britain, but usually involves only a few individuals.

An instance of contrasting behaviour comes to mind in *Heodes alciphron* Rott. in S.W. France in 1964. Freshly emerged males of this large 'Copper' were noticed feeding from flowers, a very attractive sight as this purple glossed butterfly is very nearly as large as a Small White (*P. rapae*). They were docile and easily approached, but a week later the insects had taken up territory, appeared to be uninterested in flowers, were extremely alert and darted belligerently at other insects in the typical 'Copper' manner.

Species rarely or never seen to feed

It is alleged that some species of butterflies are rarely or never seen to feed in the adult state, those most frequently referred to being: *Hamearis lucina* Linn., *Pararge aegeria* Linn., *Eumenis semele* Linn., *Celastrina argiolus* Linn., and *Coenonympha tullia* Müll. My own observations do not agree with these findings and I have personal records for all those mentioned, to which I shall refer later. It may be that the species mentioned above are not obvious feeders and are usually to be seen sitting on leaves, etc. It is worth noting however, that *aegeria* and *semele* are mainly, but not exclusively, sap-feeders and *argiolus* is addicted to honeydew.

It is interesting to note that according to Butler and Covell (1957) none of the members of the genus *Megathymus*, the North American Giant Skippers, feed at all in the adult stage. I have no personal experience of this genus, but it does not hold true for our own HesperIIDae.

Periodic and local interest in flowers

The fact of butterflies frequenting certain flowers in some years and ignoring them in others has been noticed. This applies also to locality. Dunk (1953) referring to *Strymon w-album* Knoch remarks, "There seems to be no consistency in the type of flower chosen in different years or indeed in separate areas in the same year". Wadey (1954), referring to the visits of honeybees to Hawthorn says, "Something in the soil permits nectar secretion by some hawthorns and prevents it in others".

In 1965 I found the Common Ragwort (*Senecio jacobaea* Linn.) particularly attractive to butterflies in Surrey, whereas in most other years I have found it of very little attraction. I think, though, that it is an established fact that this plant is more attractive in coastal areas than inland.

Species frequenting one food source only

Some butterflies appear to restrict themselves to but one or two sources of food, but the only species I have found to confine itself to one only is *Limenitis camilla* Linn. This flower is of course *Rubus fruticosus* Linn., sensu lato (Bramble). I have made observations on quite a few colonies of *camilla* and although young males sometimes suck salts from wet mud, Bramble is the only plant seen to be visited.

beetles whose larvae feed on wood, under conditions in which they may be observed. The most important factor would seem to be control of humidity, although with some species this can vary considerably without detriment to the larvae. The habitat under the bark of dead trees and logs can vary from wet during rainy weather to bone dry in conditions of drought.

In concluding this article I have thought it advisable to depart from the precise order of superfamilies that I suggested in the Introduction.

(To be continued)
B. J. MacNulty (4528)

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BOOK REVIEW

Butterflies by Robert Goodden. Illustrated by Joyce Bee. pp. 159. Hamlyn, London. £0.40.

It is relatively easy to cover the 50/60 species of butterflies occurring in the British Isles in a slim volume but when the reference is the whole world, the task takes on different dimensions. Robert Goodden has produced a most readable survey, generously illustrated by the talented Joyce Bee and also including a sizeable section on the basic knowledge for an intending lepidopterist.

Generally the book is aimed at the younger or less experienced collector but could well influence the older enthusiast who has confined his interests to the British fauna. The life cycle is set out in some detail including the main families and small sections cover such topics as butterfly migration, protective colouration, seasonal variation and necessary equipment. The description of breeding techniques from a professional dealer is especially valuable.

Some 200 species illustrated in colour provide typical examples of the major groups. They are divided between seven distinct areas of the world which have been relatively accessible to entomologists. The reader is given a glimpse of the temperate species of Europe, the Fritillaries and Milkweed from North America, iridescent Morphos and Heliconids from Central and South America, Charaxes and Pierids from Africa, the specialised fauna of the Australian continent and Asian species from the frozen north to the tropics.

I enjoyed reading this book and appreciated the impact of the boldly coloured plates. At 40p, it is a surprisingly good bargain.

R. D. H.

INTRODUCTION TO CRANEFLIES The Identification of British Craneflies

The standard reference works previously listed are set out on formal lines, but here I intend, as far as possible, an informal approach to the identification of Craneflies. Particular attention will be paid to some of the commoner species so that once some familiarity with the group is achieved, it will be possible to face the standard works with some degree of confidence.

With butterflies and moths identification can often be achieved by matching a specimen with a picture in a reference book, but there can be many pitfalls with this procedure. The majority of insects are identified on the basis of 'keys'. At first sight a key may look confusing, but it is really a highly organised questionnaire. Most keys are dichotomous (two branched), in that questions are arranged in pairs, the 'questions' being descriptions. You decide which description fits your insect and your decision leads you on to the next pair of questions and so on until you arrive at the name of the insect.

The name will typically consist of three words—the genus, species and person who described it. To help those who find scientific words difficult, English names have been invented on the lines of those used with moths. These names only have any basis in this paper, so every effort should be made to use the scientific ones.

In order to follow a key you must understand the features referred to in the questions. Legs black or yellow is easy to understand, but prescutum with 4 or 5 stripes involves a term to be explained. We shall consider some of the main parts of a cranefly, emphasising the most important features used in the keys.

The main disadvantage of a key is that despite looking at a variety of small features, there is still little information on the overall appearance of the species. It is therefore possible to take a wrong turning in the key, and finish up with an incorrect name which applies to an insect far different from your own specimen. An insect may have distinctive characters, yet it is difficult to tell whether there are any other similar looking species which may have caused confusion. In this introduction to Craneflies, it is intended to concentrate on the overall appearance of the species and point out unique characters or draw attention to similar species. If you find a large yellow cranefly, then for a beginner it is more helpful to know the distinction between the few common species than being confronted with a key to over 300. At the time of writing this paper, there is little immediate prospect of the *Handbook* being reprinted, so with at least the larger species some reference will be made to all of them.

Structural features

Don't be put off by all the terms, you won't need them all at once. Refer to Fig. 1 as you meet structural parts later in the text.

- (a) Head. The compound eyes are usually bare, but in one group they are hairy. With a good hand lens and contrasting background the hairs will show up. Small simple eyes, ocelli, are only present in Trichoceridae and Anisopodidae. They are situated on top of the head between the compound eyes. The antennae are composed of a number of segments, the one nearest the head being called the scape, followed by a small segment called the pedicel and the rest of the segments are termed the flagellum. The palpi are situated on a tubular extension of the mouth parts, the rostrum.
- (b) Thorax. The sides are referred to as the pleura. On the dorsal surface, the large front portion is referred to as the prescutum. In Tipulidae and Trichoceridae there is a 'V shaped' suture across the thorax, with the scutum (paired) behind and a median scutellum. The postnotum is situated just before the abdomen. The halteres are modified hind wings, as in all Diptera.
- (c) Abdomen. The segments are composed of dorsal and ventral units. Tergites are dorsal, sternites ventral. In the male the last segment is the ninth. The eighth and ninth are often both modified as part of the genitalia in the male. Fig. 1A shows one type of genitalia (*Tipula*); there are several other types to be discussed later. The female has an ovipositor at the end of the abdomen consisting of paired dorsal elements, the cerci and paired ventral elements, the sternal valves (Fig. 1B).
- (d) Legs. Each consists of a coxa, trochanter, femur, tibia and tarsus. Tibial spurs, on the underside of the apex of the tibiae, consist of two spine-like bristles, but in some groups these are absent.
- (e) Wings. These provide important features for identification purposes. The terminology may look complex but it is logical, and once mastered, can be applied to all Diptera and many other insect groups. The wings are strengthened by a series of veins. The intervening wing membrane is divided by these veins into areas called cells.
- To face a completely annotated wing map for the first time can be confusing, but the following gentle approach should iron out most major difficulties.

It is simplest to consider the main cells to begin with. There are two large elongate cells towards the base of the wing, the Upper Basal Cell and the Lower Basal Cell—these are always present and provide good markers (there is only one cell in *Mycetobia* and Anisopodidae). On the distal end of these, there is usually a small cell which is called the Discal Cell. This is the best reference point for identification of veins, but occasionally an important feature of a species is the absence of this cell. The other major cell is the narrow Costal Cell which runs parallel with the fore-edge of the wing (Fig. 2A).

We can now add some wing veins, taking a simple theoretical example (Fig. 2B). Firstly take the vein from the top outer corner of

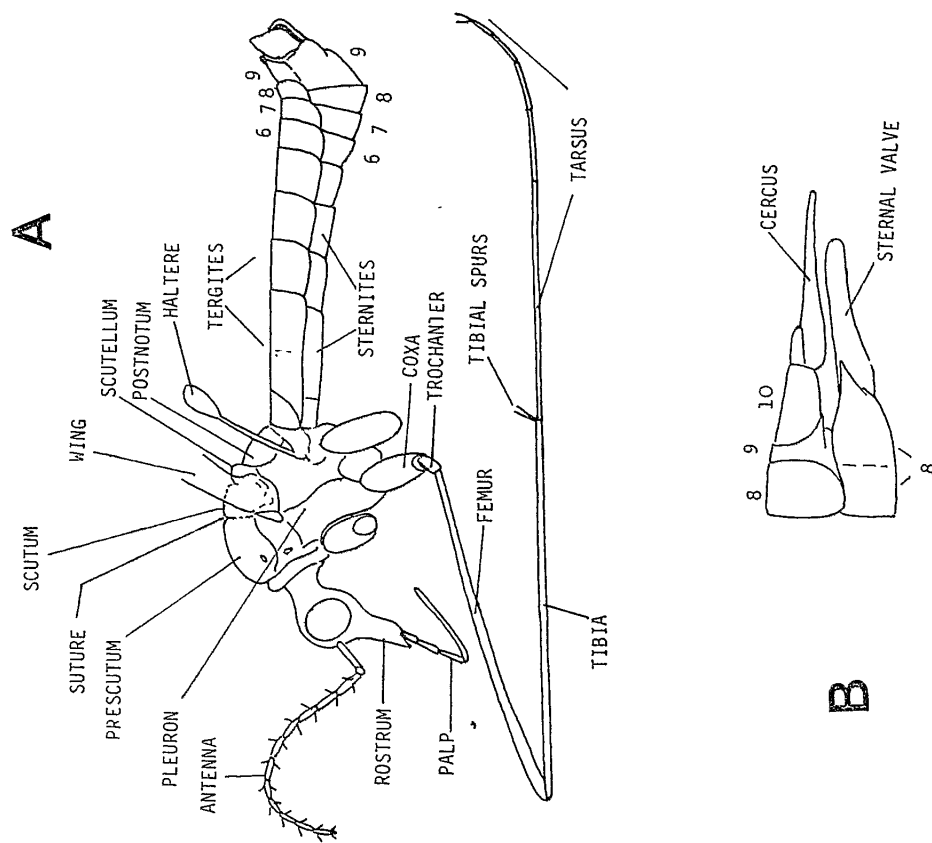


Fig. 1: Structural parts of a crane fly, *Tipula czizeki*. A. General side view of a male. B. Side view of the ovipositor of a female.

the Discal Cell—this is M_1+2 . Above there are only two veins towards the outer edge of the wing before the tip of the Costal Cell bounded by R_1 —these two veins are R_2+3 and R_{4+5} .

A more complex situation (Fig. 2C) arises if these veins branch. Vein M_1+2 divides, giving rise to a wedge shaped cell, M_1 . Vein R_2+3 divides into R_2 and R_3 , so that there are now three veins between the Discal Cell and the tip of R_1 .

That is really the major battle settled, the rest of the characters fall easily into place and are shown in Fig. 2D. Veins with small letters are cross veins, whilst the radial veins have capital letters. A few minor veins will be described in diagrams when required. The differences in

vein Sc between Figs. 2B and 2C will be referred to below. The stigma is a coloured patch about the tip of R_1 , though this is absent in some species. The squama is a thickened lobe near the base of the wing.

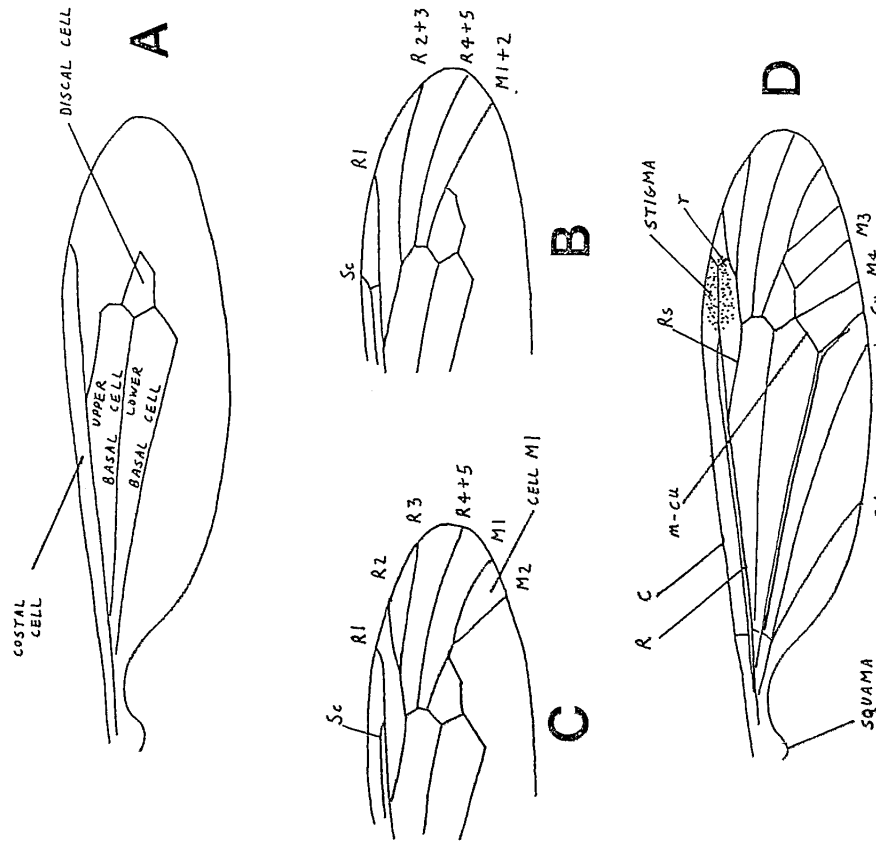


Fig. 2: Diagrammatic wing maps. A. Main cells. B. Simple wing venation as in *Limonia*. C. More complex venation as in *Tipula*. D. Complete wing venation as in *Tipula czizeki*.

Key to families

1. Two distinct and complete anal veins (veins 1A and 2A, Fig. 2D). Suture across thorax 2
2. One distinct anal vein. Suture absent 3
3. Ocelli absent. Vein 2A moderately long (Fig. 2D). True crane-flies, Tipulidae. Ocelli present. Vein 2A very short. Winter gnats, Trichoceridae

3. Ocelli present 4
4. Ocelli absent 5
5. Tibiae spurred and Rs forking at or just beyond r-m. Small species Anisopodidae
6. If tibiae spurred, Rs forking (if at all) well beyond r-m other Nematocera
7. Ten veins reaching wing margin. Not moth flies or mosquitoes. Predominantly black species Psychoteridae
8. At most eight wing veins reaching wing margin ... other Nematocera
9. In practice, the crane-fly families are quite distinct except for one genus of Anisopodidae.

TIPULIDAE

Most crane-flies belong to this family, including all the largest Nematocera, indeed one of the two largest British Diptera is a Tipulid. There are two major groups—the Long-palped Crane-flies and the Short-palped Crane-flies.

Long-palped Crane-flies (subfamily Tipulinae)

This group contains 95 species, almost one-third of our fauna, and all are large species. The smallest has a minimum wing length of 6 mm. If you have a Crane-fly with wings at least 11 mm long, and often considerably more, then with a few notable exceptions it should belong to this group.

As a check, vein Sc ends in R as in Fig. 2C. Fig. 2D shows the wing of *Tipula* (some species differ in detail). The veins are never as in Fig. 2B (R_2+3 is always divided). The palpi are long (often as long as the head), with the terminal (fourth) segment always longer than the preceding one (note that the palpi tend to shrivel up).

Other large Crane-flies can be eliminated on the following basis. Vein Sc ends in C, as in Fig. 2B. Wing veins may be as in Fig. 2B with R_2+3 undivided. Palpi usually short and fourth segment shorter. Eyes may be hairy. Of the ten or so species likely to cause confusion *Pedicia rivosa* is a very large species with bar shaped markings on the wings. Other species include some *Limonia* (R_2+3 undivided), *Pedicia littoralis* and *P. occulta* (with hairy eyes), *Pseudolimnophila* and *Limnophila* (male genitalia of a very different pattern).

Psychoteridae, with wing span 7-12 mm, look like Tipulids, but have only one anal vein and no suture (black, or black and yellow species: also no discal cell).

Key to genera of Tipulinae

1. No discal cell. Blackish species with tarsi pure white ... Dolichopeza
2. Discal cell present. Tarsi not pure white 2
3. Antennae with whorls of hairs 3
4. Antennae without whorls of hairs 4

3. Yellow and black species. (Sc ends close to base of Rs) *Nephrotoma*
Colour grey, brown, dull yellow, orange, rarely black (Sc ends far from base of Rs)
4. Grey species. Antennae of male serrate (saw-toothed) ... *Prionocera*
Black, black and yellow, or black and red species. Antennae in male with long lobes *Ctenophora*

Genus *Tipula*

This large genus contains 60 species, so a key can become lengthy and difficult for the beginner to handle. This can be a troublesome genus since the Handbook key is not easy to use and the sparsity of illustrations gives little chance to check determinations.

Most species of *Tipula* have a well defined period of emergence and there is a succession of species through the season. However, date of emergence is affected by weather and local variation arises from geographical location and altitude. Some species occur throughout the warmer months. On balance, it is possible to break down the 60 species on the basis of emergence period, an autumn group of species being especially distinctive.

Autumn species of *Tipula*

The species dealt with below include all the species known to occur in September, October and early November (these are dealt with first in view of the date of publication). Some of these are confined to the autumn, others can appear in other months.

Place your specimen into one of the following unique sets of characters.

- A Wing with a dark spot just below the centre of lower basal cell.
Large species.
- B Brown costal cell. Large brownish or greyish species.
- C Yellowish abdomen with a dark dorsal stripe.
- D Wings mottled with at least a white spot in the centre of the lower basal cell or
Wings without markings, body dull grey or brownish without dorsal line on abdomen or
Females with very reduced wings.
- E Characters not as above.

A. Isolated dark spot between veins Cu and 1A just below the centre of the lower basal cell. Apart from clear area around spot, rest of wing with ill defined brown or grey smudgy markings. (One of the species of the sub-genus *Acutipula*.)

Single-spot *Tipula* *fulvipennis* Degeer. This is a large species which is brown in the female and greyish in the male (wing length 12-19 mm). The wing spot is a unique character. Wet spots in woods and hedgerows, July-September.

B. Brown costal cell, rest of wing transparent, Fig. 2D (these species

are robust. The only other species with a brown costal cell, more marked, is *T. marginata*, a rare species of slender build related to *T. lateralis*. (Sub-genus *Tipula*). The genitalia are fairly uniform, as illustrated in side view in Fig. 1A, and the tip of tergite 9 is shown in Fig. 3a.

- 1 Eyes narrowly separated under head (= at most width of antennal scape); female with long wings. Antennae with 13 segments (including minute one at tip). Brownish species.
Mostly May-June, Sept.-Oct. *T. oleracea*
Eyes well separated under head (= at least $1\frac{1}{2}$ times width of antennal scape)
- 2 Antennae with 14 segments (minute one at tip). Females with wings not nearly reaching tip of abdomen. Brownish species.
Mainly July-early October *T. paludosa*
Antennae with 13 segments. Females with long wings. Greyish species. Only out in mid-October, scarce *T. czizeki*
Marsh Brown-edged *Tipula* *oleracea* Linn. The main emergence is in early summer with a partial autumn appearance. Prefers damp meadows and woods.

Meadow Brown-edged *Tipula* *paludosa* Meigen. A common species whose larvae are the most frequent leatherjacket in lawns. July-August in Upland districts, August-early October in the south.

October Brown-edged *Tipula* *czizeki* de Jong. A little known species. Always check for this species when recording this group in October. In the field it is readily recognised by its grey, rather than brown appearance, but occasionally late specimens of *paludosa* can look greyish.

- C. Dull yellowish abdomen, which has a blackish dorsal stripe.
Thorax grey or yellow-grey.

The two species are out from August until October. (Sub-genus *Platytipula*.)

Yellow-winged Autumn *Tipula* *luteipennis* Meigen. The wings are strongly yellowish, including most of the wing veins. In the male, tergite 8 is distinct (Fig. 3b), and sternite 9 lacks a median plate. Locally frequent around ponds, marshes and marshy woods.

Bog Autumn *Tipula* *melanoceros* Schummel. The wings are not noticeably yellow and most wing veins are blackish. The male has a distinctive table-tennis bat shaped process from sternite 9 which projects upwards (seen from behind), Fig. 3d, and tergite 9 is very different—the downward pointing median spine is shown in Fig. 3c. Locally common around bogs and acid wet woods.

- D. (Sub-genus *Savishenkia*.) Most species are confined to the autumn, two occur more widely through the year, and three (*T. cheethami*, *T. griseus* and *T. subnodicornis*) only occur earlier in the season. With 11 autumn species, this is the predominant group at this time

of year. Since females are often difficult, main emphasis is placed on males.

The best character for separating the species is the form of the eighth sternite, as illustrated in Fig. 3e-o where the features of the hind edge are shown.

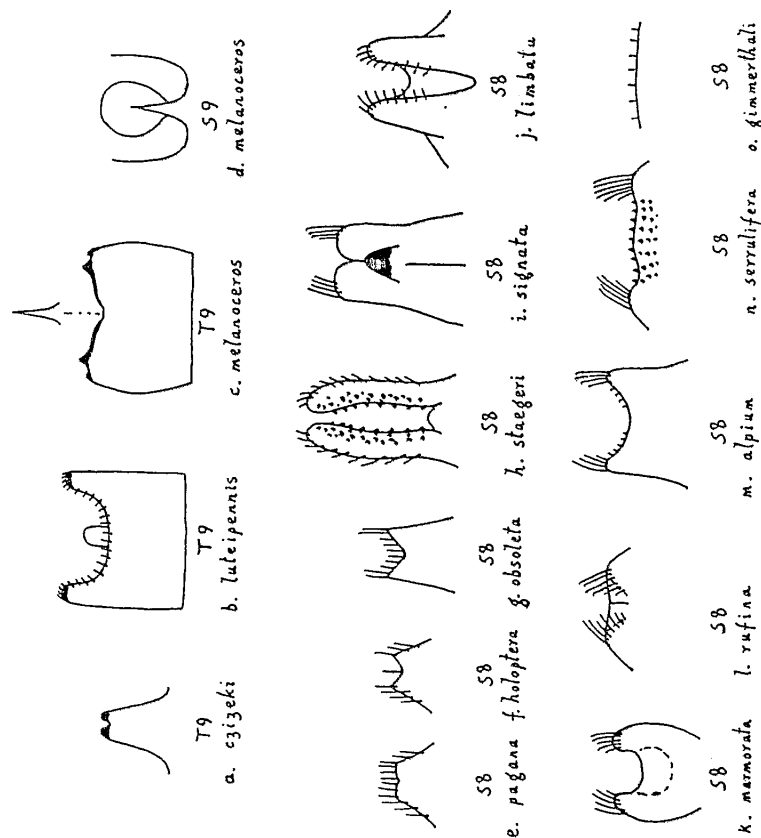


Fig. 3: Details of the male genitalia of autumn *Tipula* species. (Not to scale.) a. Dorsal view of tip of tergite 9 of *czizeki*. b. Dorsal view of complete tergite 9 of *luteipennis*. c. Dorsal view of complete tergite 9 of *melanoceros*, with indication of shape of downward projecting spine. d. View from behind to show upward projection at tip of sternite 8 of *melanoceros*. e-o. View from below to show hind margin of sternite 8 of *Savchenkia* spp. (Note that *k* is a view obliquely from behind, giving a distorted impression that the segment is heart-shaped.)

The species fall into the following groups:—

- (a) Plain wings. *T. pagana* males and both sexes of *T. holoptera*. The details of a slight median tab-like extension to sternite 8 separate the males (depth of notch and presence or absence of conspicuous median hair in notch). Fig. 3e and f.
- (b) Mottled wings and distinct tab-like extension to sternite 8. *T. obsoleta*. Fig. 3g.

- (c) Mottled wings and paired median lobe like extensions to sternite 8. *T. staegeri*, *T. signata*, *T. limbata*. Fig. 3d-f.

- (d) Mottled wings and membranous or fairly simple median area to hind edge of sternite 8. *T. marmorata*, *T. rufina*, *T. alpium*, *T. serrulifera*, *T. gimmerthali*. Fig. 3k-o. Note that *T. rufina* in both sexes has a strongly marked and continuous black band running from the neck to a point on the pleura below the base of the wing. Females with very reduced wings. *T. pagana* and *T. gimmerthali*. In *pagana* the wing venation is normal, but in *gimmerthali* the venation becomes very complex at the wing tip.

Drab Autumn *Tipula pagana* Meigen. A dull brownish or greyish brown species with uniformly clear brownish wings which is common in open or lightly wooded situations, even on moorlands. It occurs between August and November. The flightless female should be searched for on the ground.

Scarce Drab Autumn *Tipula holoptera* Edwards. The males can only be separated with great care (note a median hair isolated within a V-shaped notch at the end of the slight tab). The fully winged females are readily recognised. Of the few known localities, heathlands predominate. October.

Tabbed Autumn *Tipula obsoleta* Meigen. A frequent species whose habitat requirements are poorly known; open grassland has been recorded. Only the preceding two species have a median tab-like extension to sternite 8 but in this species it is much more strongly marked and it differs in having mottled wings.

Long-lobed Autumn *Tipula staegeri* Nielson. One of the easiest *Craneflies* to recognise because of its long lobe-like extensions to sternite 8, with small spines on the inner sides. This species occurs in marshy woods, as well as some drier situations, in September and October.

Trifid Autumn *Tipula signata* Staeger. This species is often found with the previous species, but the three part extensions to the eighth sternite, consisting of two lobes and a short median black tab, are very distinct. September-November.

Northern Autumn *Tipula limbata* Zetterstedt. A rare species known from Scotland and Northern England. The well-spaced lobes with a whitish median wedge shaped area between are unmistakable. September.

Mottled Autumn *Tipula marmorata* Meigen. Very common in a wide variety of situations, but elusive in the field, though often coming indoors. The larvae live in moss and the adults can be found flying over mossy ground in woods. The adults also tend to sit on tree trunks where they are well camouflaged. The wings are heavily mottled and the pleura are also mottled with dull patches. This tends to be a rather delicately built species with the two lobes on sternite 8 situated at the corners of a yellowish

U-shaped membranous area. Sometimes as early as July, but mainly September and October.

Striped Mottled Tipula *Tipula rufina* Meigen. A very distinct species when the broad chocolate brown stripe on the side of the thorax, extending from the neck to a point just below the wing base, is well marked (*marmorata* and *alpinum* have a less distinct stripe). The larvae live in moss in open or wooded situations. It is widespread and sometimes comes indoors, but in the south it is difficult to find in the field even where mosses are abundant. April until November.

Upland Mottled Tipula *Tipula alpinum* Bergroth. In hilly districts in Wales and the north this species can be common from high on mountains down to low level situations. It is particularly fond of hiding under overhangs of peat on peat hags and by trackways etc. or of sheltering around boulders. There is a broken brownish stripe less complete than that on *T. rufina*, but some individuals can be easily confused. The small spines along the hind edge of the eighth sternite are diagnostic but require close scrutiny. May-September.

Long-horned Autumn Tipula *Tipula serrulifera* Alexander. A very rare species known from the Edinburgh district and the Wyre Forest in Worcestershire. Great care is needed in identifying this species since the diagnostic features of the eighth sternite are not easily seen—the rows of tiny black teeth between ill-defined lobes with brushes of golden hairs. The antennae are exceptionally long in the male, as long as the thorax and head together. August and September.

Pentland Autumn Tipula *Tipula gimmerthali* Lackschewitz. Originally described from the Pentland Hills near Edinburgh but now also known from the north Pennines. A greyish species with poorly marked wings. The eighth sternite is simple with only a row of small hairs along the hind margin. The female is wingless, as in *T. pagana* but the wing venation is complex at the tip. October. (Note some specimens may appear to have uniformly greyish wings as in *T. pagana*, but sternite 8 is characteristic. It is just possible that *T. scripta* could appear as late as early September and this has a simple sternite 8; *scripta* is a large yellowish brown species with a yellow first flagellar segment rather than black as in *gimmerthali*.) Others. There are only three other Tipula species recorded in the autumn, but these belong to summer groups (occurring as late as September), so will be considered in detail in the next part where closely related species will be considered.

Tipula lateralis Meigen. A common waterside species with a grey stripe along the dorsal line of the abdomen and flanked by a broad dark brown line either side. Wings dull greyish with a white patch below the stigma.

E.

Tipula solstitialis Westhoff. A closely related scarce species with predominantly yellow, instead of predominantly black, genitalia.

Tipula cava Riedel. A large completely orange-yellow species usually found on heathland and dry woods.

In addition, *T. scripta* Meigen could occur as late as September. See footnote under *T. gimmerthali*.

Note that the genus *Prionocera* can easily be mistaken for *Tipula*. One species occurs as late as September on boggy ground and is the only large crane fly in the autumn which is grey with a black dorsal line along the abdomen.
(To be continued)

Alan E. Stubbs

REPORT OF THE AES COUNCIL FOR 1971

During the year the Council met six times under the chairmanship of Mr Eric Bradford. The Council is happy to report that the expansion of the Society continues, the net membership increase for the year being 70.

Bulletin

During the year the Society was affected by the postal strike and this caused delays in publication and posting of the *Bulletin*. The standard of material published continued to be high; the articles on the study of Coleoptera, commenced the previous year, continued and Mr Bradford illustrated more of the Microlepidoptera.

Publications

The stocks of the very popular pamphlet, *Killing, Setting and Storing Butterflies and Moths*, ran out and it was decided to publish a revised pamphlet including extra material. The result is that a new pamphlet of twenty pages is now ready for the printers.

Exhibition

The Annual Exhibition was again held at the Holland Park Schools. It was better attended than in previous years and was financially successful. However, the fall off in exhibitors and the increase in the sales of material by traders and members has caused the Council to take the action published in the February 1972 *Bulletin*. It is hoped that this will remedy the situation.

Finances

Despite the warning that subscriptions would need to be raised, careful management of the finances and increased membership has enabled the Council to postpone this for at least a year. However printing and postal charges have again risen steeply and increases seem inevitable. The sale of the Society's publications have again proved very satisfactory and the Society is indebted to its agent, Mr L. Christie.