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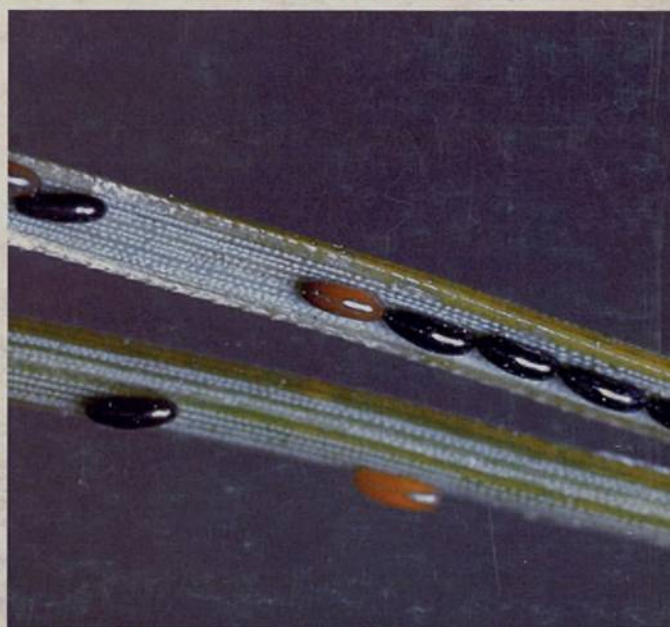
Conifer Lachnids

C I Carter N R Maslen



Cover:

Top: Colony of *Cinara piceae* on the stem of pole stage Norway spruce. The largest aphids are mature apterous virginoparae; an oviparous female showing the white pericaudal wax ring is on the left centre of the colony. (C/S 35753)

Bottom left: Colonies of *Schizolachnus pineti* on the needles of Corsican pine transplants showing the densely packed aphids and the wax coating over their body surfaces. (C/S 35752)

Bottom right: Eggs of Pine aphid *(Cinara pini)* on pine needles showing characteristic grouping and colour change from yellow (of new laid egg) through brown to black. (C/S 35751)

FORESTRY COMMISSION BULLETIN
No. 58

Conifer Lachnids in Britain

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CONTENTS

ABSTRACT

Field keys and morphological keys with descriptions and illustrations are given for the identifications of the 27 aphids of the family Lachnidae known to occur on conifers in Britain. The strong influence of their host plant upon these insects and the impact some of them have on the growth of forest trees and amenity plantations throughout the world is discussed. The importance of conifer aphid honeydew from various species in the production of forest honey is reviewed. Accounts of each species include recent synonymy, descriptions of morphs, type of life cycle, host plants, distribution and economic importance.

SOMMAIRE

L'article comporte des tableaux d'observation sur le terrain et morphologiques accompagnés de descriptions et d'illustrations permettant l'identification des 27 pucerons de la famille Lachnidae qui sont trouvés sur les conifères en Grande Bretagne. L'influence considérable exercée par l'amphitryon sur ces insectes et l'effect de certains d'entre eux sur la croissance des arbes forestiers et des plantations d'agrément dans le monde entier sont traités. L'importance de la miellée de diverses espèces de pucerons des conifères pour la production du miel de forêt est considérée. Les profils de chaque espèce comprennent la synonymie récente, descriptions des formes, le genre de cycle vital, les amphitryons, la distribution et l'importance pour l'économie.

ÜBERSICHT

Zur Bestimmung der 27 Arten von Blattläusen der Lachnidae Familie, die auf Großbritanniens Koniferen vorkommen, werden Feldbeobachtungs— und morphologische Klassifikationstabellen, sowie Beschreibungen und Illustrationen, angeführt. Es wird der starke Einfluß behandelt, den die Wirtspflanze auf diese Insekten ausübt, sowie andererseits deren große Wirkung auf das Wachstum der Bäume und der Parkanlagen der ganzen Welt. Die Bedeutung des Honigtaus der verschiedenen Arten von Koniferenblattläusen bei der Herstellung von Waldhonig wird betrachtet. Die Berichte über die einzelnen Arten enthalten die neueste Zusammenstellung wissenschaftlicher Namen, Beschreibungen der Formen, Typen des Lebenszyklus, Wirtspflanzen, Ausbreitung und wirtschaftliche Bedeutung.

1. INTRODUCTION

This bulletin brings together recent information on the various species of conifer-feeding aphids belonging to the family *Lachnidae* that are known to occur in Britain. The specimens studied have been mainly derived from collections made in Britain over the past 15 years from plantations and arboreta or those accompanying forest and nursery enquiries sent to the Forestry Commission. Keys are given for the identification of both living aphids and prepared specimens. Individual accounts for each species include descriptions of the feeding sites, host plants, life history, economic importance and distribution.

The family *Lachnidae* is a distinct part of the super-family Aphidoidea and can be readily recognised by certain morphological features. The life cycle of lachnids is completed on a single host plant and does not therefore have the woody plant/herbaceous plant alternation pattern so familiar in many agricultural aphid species. Some lachnid species attain a very large size for the super-family. They may also possess very long mouthparts with which to pierce the bark of trees and reach the sappy tissues containing their liquid food.

All conifer lachnids have a very limited host range, nearly always confined to one plant genus and often restricted to a few species. Of the many conifers now grown in Britain only two of the three native species *(Pinus sylvestris* and *Juniperus communis)* are host plants.

Until recently not much special attention has been given to the lachnids in Britain. The increase in numbers of species recorded now in 1980 over those listed in *A Check List of British Insects* (Kloet and Hinks, 1945) illustrates the point. This lack of attention contrasts with a traditional interest in the group in other parts of Europe where the potential of lachnids to damage growing conifers has long been recognised as has their value as producers of highest quality honeydew, the raw material for forest honey. The reputation of honeydew amongst British beekeepers in this last respect is curiously at variance with that of their European counterpart, and it is quite certain that whilst the former has based his opinion on an inbuilt suspicion of the untried, the latter has relied on centuries of experience.

A recent taxonomic review of the genus *Cinara* by Dr V. F. Eastop has been a basis upon which the present biological work has developed. Duplicates of the many species encountered have been deposited with him at British Museum (Natural History). Similarly, access to the Rothamsted Insect Survey material kindly allowed us by Dr L. R. Taylor has provided opportunity for the building of a more comprehensive picture of the distribution and dispersal behaviour of each species.

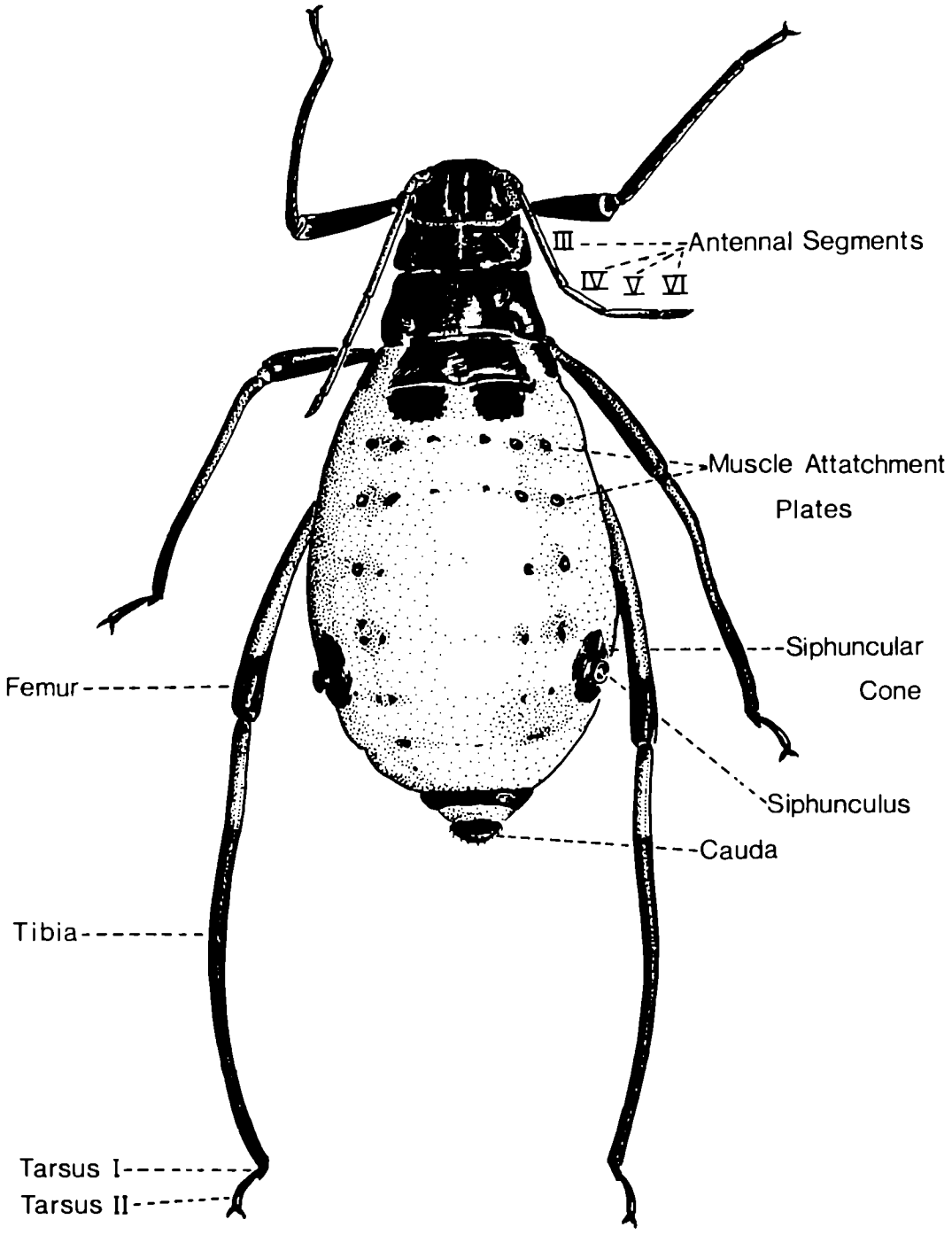

Figure 1. General morphological features of an apterous viviparous female of *Cinara piceae*.

2. THE ASSOCIATION OF CONIFER LACHNIDS AND THE HOST PLANT

Feeding sites and damage

Keen (1938) reported that several species of lachnids cause considerable injury to conifers in North America. The visible signs of this injury are usually a yellowing of foliage or a reduction of growth especially of young trees (Furniss & Carolin, 1977). Where a particular species of lachnid feeds, at any one time of the year, is often restricted and does not vary much from tree to tree (Bradley 1959). There is, however, a tendency for some species to gradually move as a colony to other feeding sites on the same plant during the year. This may be done to exploit new food sources which become available as the season progresses or to acquire some protection.

Aphids have to insert their piercing mouth-parts through various layers of plant tissue to reach cells rich in nutrients. Lachnids are the giants among the aphids and many species are equipped with exceptionally long piercing mouth-parts to exploit the food source beneath the bark of stems and branches of mature trees. As the long mouth-parts are forced into the plant, enzymes are injected with saliva to assist penetration between plant cells. Sometimes at these sites, where sap-feeding Hemipterous insects feed, odd tissue deformities or characteristic galls develop.

Effect of stem feeding species on growth

The growth reactions of plants to local auxin applications are not unlike galled tissue caused by insects. This analogy led Nuorteva (1956) to look for the presence of plant-growth substances in the saliva of certain Hemipterous insects. Amongst the insects tested in the bioassay was the colonial stem-feeding *Cinara piceae*. Though this aphid does not produce anything in the form of a gall, Nuorteva's investigation showed that high concentrations of salivary gland extract caused a marked inhibition of plant growth. Exactly how aphids benefit from this is not known, nor has the effect of a heavy infestation on spruce been investigated. *Cinara todocola* is another similar stem dwelling aphid which is noticeably destructive feeding throughout the growing season on stems and branches of *Abies sachalinensis* and *A. firma* in Japan. Inouye (1958) reported that in Hokkaido it caused a marked reduction in growth and, where young trees are attacked, they lose their resistance to secondary insects, fungi and drought and death may result after being infested for two or three years. Johnson (1965) found that infestation by stem feeding *Cinara* spp. reduced the growth of young Douglas fir so their growth was only ¼ to ½ that of uninfested ones.

Effect of foliage feeding species

Species of the genera *Eulachnus* and *Schizolachnus* feed and make colonies on the needles; whereas those in the genus *Cinara* choose other parts of the tree although some species do feed in close proximity to needles or on new shoot axes that are green and unlignified. The probing behaviour of *Eulachnus agilis* on pine foliage, described by Bliss et al (1973), caused chlorosis and premature dropping of needles. Although there are no obvious morphological changes in the plant, it is thought that the salivary secretion may have physiological effects such as increasing respiration and decreasing photosynthesis. Both *Schizolachnus pineti* in Britain and *S. piniradiatae* in North America live in small dense colonies on pine needles causing the attacked needles to senesce prematurely. Under heavy attacks, a large proportion of a tree's photosynthetic area can be lost. Thompson (1977) found high densities of *S. pineti* associated with a marked reduction in growth of young pines.

Effect of shoot and twig feeding

Periodic attacks from *Cinara cupressi* have occurred over a number of years in Europe. Its presence is not always easily detected, but hidden colonies on *Cupressus* spp. can sometimes be located by extensive sooty mould fungi on the lower foliage (Fox Wilson, 1948). Bad attacks can also occur on certain *Thuja* and *Juniperus* species as well. Gunkel (1963) described the symptoms of reddening of needles and twig death, which can often lead to whole plants dying. Luisi and Triggiana (1977) report a widespread occurrence of aphid damge to *Cupressus* in recent years in Central and Southern Italy. Other general reports of this damage indicated that the bark invading fungus *Seiridium (Coryneum) cardinale* was possibly responsible. However, there seems to be no doubt in the epidemic of 1976/78 that *C. cupressi* has been the prime agent (priv. comm. Intini & Panconesi), and that other generally saprophytic fungi *Pestalotia funerea* and *Coniothyrium* spp. are subsequently found on the dried foliage. Another closely related species is *Cinara fresai*. It has caused serious damage to both *Juniperus bermudiana* and *J. silicicola* in Bermuda. Defoliation and death of twigs results from feeding at the base of leaflets and twigs (Wang & Hughes, 1976). In Eastern USA *Cinara strobi* appears to have

detrimental effect on the growth of White pine (Baker, 1972); in Britain *C. pini* feeding in colonies on pine shoots is suspected of reducing vigour or even killing shoots.

Colonies of *Cinara pilicornis* on young shoots of Norway spruce appear to cause chlorotic discolouration and premature fall of the adjacent young needles (Varty, 1953). Eckloff (1972) has discussed the removal of photosynthate on young trees and the diminution of seasonal growth rate up to 38% by another species *C. stroyani* which feeds on the lignified twigs of spruce.

Two aphid species *Cedrobium lapportei* and *Cinara cedri,* have recently spread northwards from Southern Europe and made serious attacks on cedars (Emonnot et. al. 1967 & Covassi 1971). *Cedrobium lapportei* seems to have a discrete feeding site between the scales of the dwarf shoots. It is a spring feeder and large numbers rapidly build up causing most of the previous years needles to fall before the new ones appear. Repeated attacks have given rise to die-back of branches. The much larger aphid on *Cedrus, Cinara cedri* is also now classified as a pest because it defoliates shade trees that are important in France and Spain (Fabre, 1976; Notario et. al. 1978).

Root feeding species

So far no single species has been found feeding exclusively on conifer roots. Nevertheless species that feed on the trunk and root-collar at certain times of the year, eg *C. kochiana* on larch and *C. confinis* on Silver fir, do migrate to the roots for part of the year. This particular niche may present problems with honeydew accumulation as there is nothing to repel or isolate honeydew droplets such as filamentous wax that is secreted by successful root feeding aphids. It may be therefore that large colonies of these aphids can only develop on roots when ants are in attendance. Another species *C. cronartii,* which feeds on pines in warmer regions of the world, may be a clue to this behaviour. It seems to be exclusively parthenogenetic everywhere it has been recorded. In South Africa, Van Rensburg (1979) found it attended by ants, surviving the summer period on pine roots in the ground so as to avoid the heat. Numbers increased on the aerial parts of the tree during the cooler autumn and winter. The dispersal of alatae took place in late winter, followed by a rapid decline of colonies from the tree crowns at the start of summer presumably as the habitat and/or food became unfavourable.

Nursery and ornamental tree-feeding species

Various species of Juniper both in their young stages and when grown as ornamentals (Vezirov & Alieva 1974) are readily attacked by *C. fresai.* In Britain this has been especially noted on plants grown under glasshouse conditions. Similarly *C. tujafilina,* which feeds on various species within the Cupressaceae, is a frequent nursery pest in North America (Brown and Eads, 1967; Baker, 1972). It is also very common on *Thuja orientalis* in the Middle East (Bodenheimer and Swirski, 1957) and possibly also in New Zealand (Cottier, 1953).

Seedling pines are periodically infested with various Lachnids in Britain. The sedentary colonies of *Schizolachnus pineti* are perhaps more obvious in Britain but often *Eulachnus* spp. and *Cinara pinea* occur as the plants get older. In North America *Eulachnus agilis* causes serious needle loss of young pine trees especially when grown as Christmas trees (Bliss & Kearby 1971; Cameron 1971). In South Carolina, Fox and Griffith (1977) found *C. watsoni* and *C. atlantica* to attack the more vigorous of *Pinus taeda* seedlings. This attack stunted terminal growth and reduced stem diameter growth.

One or two-year old lined-out transplants of both Norway and Sitka spruce are frequently attacked by *C. pilicornis.* Varty (1953) records that 60% of the new needles were lost on the worst affected Norway spruce. On several occasions in late spring we have seen an abundance of earth shelters constructed by ants up the stems of transplants over small colonies of *C. pilicornis* in the heathland sandy nurseries in Southern England.

Feeding on wounds or other weakened tissues

New scars on stems commonly made by brashing and the thinning marks (blazes) in pole-stage spruce plantations often attract groups of *Cinara piceae* when colonies are already present on the tree. *Cinara cornartii* has the peculiar habit of occurring throughout the year in lesions or cankers of the rust fungus *Cronartium fusiforme* on pines in North America (Tissot & Pepper 1967). Although this aphid itself is not considered a pest, its apparent liking of the pine lesions and ability to disperse may contribute to the spread of the disease.

Sooty moulds

Honeydew excretions from aphids are rich sugary solutions containing sucrose and glucose. In the

absence of heavy rain this liquid accumulates on the vegetation beneath and forms an ideal substrate for saprophytic sooty mould fungi to develop. In extreme cases sooty moulds completely obscure the natural colours of foliage and twigs with a dull blue-black covering of hyphae and spores. On Norway spruce this damage, caused by *Cinara pilicornis* and sometimes *Elatobium abietinum* can markedly reduce their quality as Christmas trees. *Cedrobium lapportei* on Cedar is another aphid that produces copious honeydew and dense sooty mould growth. The sooty mould problem is of most concern where trees are grown for amenity in parks and along roadsides. The problem is not, however, confined to Britain. Wang and Hughes (1976) report *Cinara fresai* and the sooty mould *Capnodium citri* on *Juniperus bermudiana* and *J. silicicola* in Bermuda. The fungi themselves are thought only to be saprophytic. Nevertheless, when they grow on green leaves they must filter out much of the sunlight required for photosynthesis. The most common fungi on fir honeydew that were identified in a study made in Poland were *Capnophialophora pinophila* and *Trichosporium pinophilium* (Borowska & Demaniaowicz 1972).

There are no plant viruses that have been convincingly demonstrated to occur in conifer foliage. The virus-like conditions of chlorotic foliage that were described by Čech et. al. (1958), and the possibility of insect transmissions by *Cinara pilicornis* attributed to Pintera (1955) led to some speculation that conifer virus diseases were present in Britain (Biddle & Tinsley 1968). Investigations by Biddle (1970) report that certain of the previously suspected virus particles had a terpene composition, proved negative in transmission tests and were therefore unlikely to be virus material.

Feeding sites and the length of the mouthparts

Many of the conifer feeding lachnids have extremely long rostral segments to their mouthparts. Of all the aphid groups it is the lachnids that show the greatest extension of these segments. It has often been generalised that those species with short rostra feed on smooth leaved herbs and those with long rostra feed on hairy plants or through thick bark. In a study that covered a range of species and host plants in Ontario, Bradley (1961) found a significant positive relationship between bark thickness and the rostral length of *Cinara* spp.

The rostral length measurement is a useful feature for segregating species. By making measurements over a number of instars, Bradley (1961) showed that the rostrum changed in length far less than the antennae and the hind tibiae during this period of growth. For bark dwelling species this feature ensures that an aphid born on the stem of an old tree can feed near to its mother rather than having to walk a great distance to thinner barked tissues before taking its first meal. However, the occurrence of colonies of *C. piceae* on the youngest shoot in the spring and their subsequent gradual movement to thicker and thicker branches does not seem to be wholly related to the rostral length and bark thickness, some other explanations are more likely. Firstly, certain species of aphids move after each moult. Secondly, for no obvious reason, colonies containing adults move as a discrete dense patch to other parts up or down the stem of a tree. There is the possibility that by moving about, aphids are exploiting different areas that act as temporary 'sinks' brought about by their feeding activities and are seeking areas rich in nitrogenous materials upon which they are so dependent.

In Britain the specific feeding sites of many of the conifer lachnids on pine, spruce and larch have now been discovered; other species, however, have been difficult to track down while some have mostly been recorded as winged forms collected in suction traps. Following Bradley's (1961) work relating species rostral length to thickness of bark at the feeding site, it is of interest to compare certain British species in this respect. The mean rostral length measurement for a range of species on four host plant groups is shown in *Fig 2.* As bark thickness varies to a great degree across the conifer genera it would be unwise to draw any rigid conclusions, but from a comparison of various species of aphid on the same plant it may be useful to speculate as to likely feeding sites when these are not known.

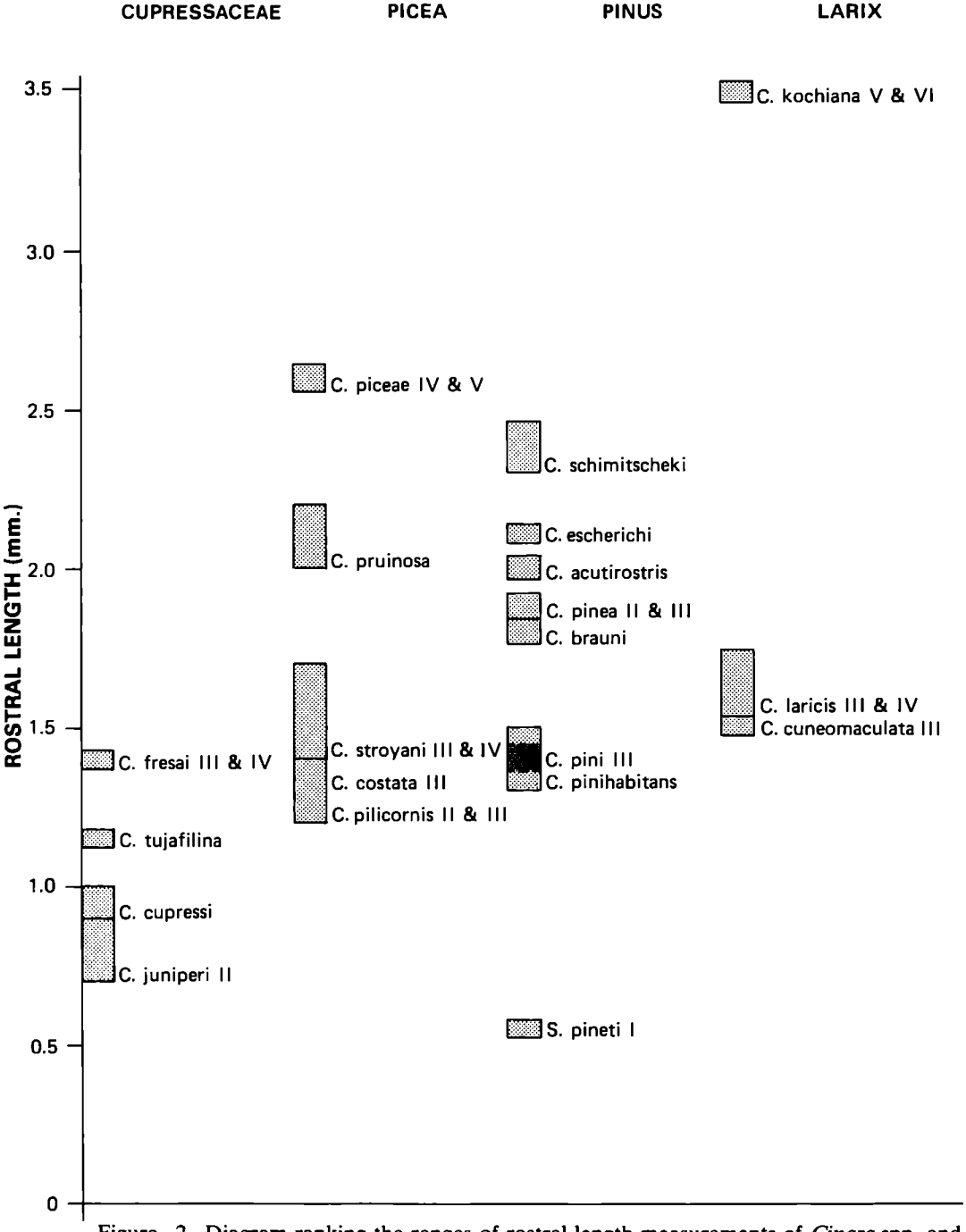

Figure 2. Diagram ranking the ranges of rostral length measurements of *Cinara* spp. and *Schizolachnus pineti*. The feeding sites of each species (where known) are given in the following code:

I needles
II new unlignified shoot axes
III one year old twigs
IV small branches
V main stem of tree
VI buttress and roots

3. HONEYDEW

Conifer Honeydew and its significance to beekeepers

By their very nature as feeders on rich phloem sap, probably all conifer lachnids produce a waste sugary excretion known as honeydew. Beekeepers in Central and Eastern Europe have for some time realised that their coniferous forests can give good yields of 'forest honey' which is highly regarded. Little appears to be known, however, of this resource in North America in spite of the vast tracts of endemic coniferous forests. In Britain certain honeydews have in the past earned themselves an unfavourable reputation as the resulting honey is said to have poor keeping qualities and is unsuitable as stores for overwintering bees. Unfortunately these points of view have been extended to all honeydew sources. The three species of European conifers that are suitable for forest honey *Abies pectinata, Picea abies* and *Pinus sylvestris* have in the past been widely planted here and their insect fauna is well established. Kloft (1963) has emphasised that the honeydew harvest from such woods and forests is becoming increasingly important in temperate zones. The 'improvement' of marginal land and intensive agricultural methods such as chemical weed control have resulted in the loss of traditional bee foraging areas.

Silver firs as honeydew plants

The European Silver fir *(Abies pectinata)* is the host plant for *Cinara pectinatae* which is one of the most useful honeydew producing aphids for apiculture (Cirnu, 1972 and Maquelin, 1975). *C. pectinatae* is not limited to the European Silver fir for we have now found it on various species of *Abies,* some of which are repeatedly infested year after year. Another very large aphid, *C. confinis,* also feeds and produces honeydew on *Abies* spp. so does a scale insect *Physokermes hemicryphus.* The honey produced from *Abies* in Rumania is considered to be outstanding (Cirnu, 1972). In Yugoslavia the early honey is produced by *P. hemicryphus* in June while *C. pectinatae* is more productive in July and August. Rihar (1977) examined the frequency of honeydew flows from fir and found that out of 49 years there were 28 with a flow of which 14 included *C. pectinatae.* In Central Europe in the drought year of 1976, the honey yields from bees visiting Silver firs were exceptional. There are some unconfirmed suspicions that at this time the high infestations of honeydew-producing insects contributed to tree mortality (Horndasch, 1977).

Pines as honeydew plants

Both *Pinus sylvestris* and *P. nigra* are hosts for *Cinara pini,* one of the most productive of the pine aphids (Zoebelein, 1956). The larger species of aphid *C. pinea,* according to Cirnu (1972), is also an important yielder during June and July; *Eulachnus* spp. contribute to the flow as well. *Cinara pinihabitans* is known from *P. sylvestris* and *P. mugo* and is a good honeydew excreting species (Fossel, 1969). In the mountainous districts of Austria (but not at low altitudes) *C. cembrae* produces copious honeydew when feeding on *Pinus cembra* (Fossel, 1971). Migratory beekeeping in German pinewoods has already become established in order to exploit honeydew flows (Scheurer, 1976).

Spruces as honeydew plants

Norway spruce has perhaps been studied in this respect more than any other spruce species grown on account of its common occurrence in Europe. Only one of the important aphids, *Cinara stroyani* appears to be confined to Norway spruce; the other two, *C. pilicornis* and *C. piceae,* commonly occur in Britain on Sitka spruce and certain other exotic species including Serbian spruce *(Picea omorika). C. pilicornis* is an early species, often occurring in large colonies within new shoots that are extending in late May and early June. This aphid is recognised as an important contributor to forest honey in Schleswig-Holstein and Danish Jutland (Kloft 1963). Its honeydew has been seen to be attractive to honey bees in East Scotland and in Wiltshire. On the stems of spruce *C. piceae* is a well-known honeydew producing species. It is regarded as the most important producer of honeydew flows in the higher Alpine forests (Kloft 1963) as well as various parts of Germany (Gleim, 1978). In Britain it occurs at all elevations and is widespread from the drier counties to the high rainfall forests in the west.

Possibly the most productive aphid on spruce is *C. stroyani* a species that lives on the fine twigs among the foliage of spruce. It is interesting to note that it fills the same ecological niche as that of the best honeydew producing lachnids found on *Abies* and *Pinus.* The scale insect *Physokermes hemicryphus* (a prolific yielder of honeydew) also feeds in twig axils in the same region of both spruce and fir.

Colonies of *C. stroyani* that have been found on Norway spruce in Britain have been in dry areas. It is most abundant and productive in July and dwindles in strength as the summer declines. Gleim

(1977) reports similar seasonal trends in Germany. Temperatures greatly influence honeydew excretion rates. Eckloff (1972) found the rate to double when the temperature was raised from 15°C to 25°C.

Honeydew sugars

The sugar composition of honeydew has received some detailed attention, firstly to resolve the question of its suitability as an alternative to nectar as a forage for bees, and secondly to examine its food value when converted into honey. Phloem sap may contain up to 20% sugars and although the precise composition may vary, sucrose, fructose and perhaps glucose are the usual components. Nectar is more concentrated (60–70% or more sugar) and contains one or a mixture of these sugars in varying proportions.

Different sites on the same plant and changes in physiology during the season bring about concentration changes. Honeydew and nectar are the raw materials of honey and both are derived from the sap of phloem cells. The processes that phloem sap from various sources undergoes during its conversion to honey have been reviewed by Maurizio (1962), and that of forest honey by Sabatini and Spina (1972). Certain enzymes are present in the aphid gut that convert some of the sucrose into monosaccharides and trisaccharides. Investigations on honeydew composition by Maurizio have shown that in addition to sucrose, fructose and glucose, a variety of sugars melezitose or raffinose, turanose or galactose and various oligosaccharides may be present. The proportions of these sugars vary according to the plant species and the insect species even when feeding on the same plant. The processes which take place during the conversion of any of these sugar solutions into honey are complex and involve sequences of enzymetic action. The flower nectar, the aphids, and the bee all contribute enzymes that bring about changes in sugar composition (Maurizio, 1962).

Mixtures of sugars are more attractive to bees than one sugar of the same concentration, so the relative proportions are significant. Glucose and fructose (ie hexoses) invariably make up 80–90% of the total sugars in honey; whereas sucrose is low, usually only 2–4%. Apart from the hexoses, di-, tri- and oligosaccharides are present in honeydew. A relatively high melezitose content (4–11%) is characteristic of certain forest honeydews. There have been some doubts about the nutritional value of melezitose to honey bees (Hey, 1956 and Recaldin, 1969). However, there is good experimental evidence to show that bees can cope with all these sugars. Some are more readily broken down by enzymes from the hypopharyngeal glands, other by enzymes from the mid-gut. Of the sugars so far tested with enzymes from honey bees, only lactose appears not to be changed, (Maurizio, 1962). In feeding experiments with a range of sugars found in plants, only galactose, mannose and rhamnose were found to be detrimental to honey bees (Geissler and Steche, 1962). There has been some concern about whether some of these sugars in honeydew cause toxic problems to bees (Egger, 1975). However, Kurir (1976) interprets the experimental results from which these views were deducted more favourably and offers the explanation that preferential tests on various sugars demonstrated differences in palatability to bees rather than toxicity.

Honeydew and other insects

A number of insects use forest honeydew as food. According to Zoebelein (1956) parasite adults, ichneumons, tachinids, syrphids etc all make use of honeydew. Zoebelein also observed that the life span of certain insects using this food source was lengthened (often many times) and that more eggs were laid. Honeydew is also thought to increase the abundance of social wasps in fir plantations in Japan (Yamane and Kamijo, 1976). Certain aphid predators (lacewings and ladybirds) are strongly attracted to honeydew, and their presence in any numbers is often a good indicator of honeydew producing aphids. The predators will even take an interest in sugary sprays when applied to foliage. But only when yeast extracts or protein-like materials are added to such sugar sprays the predators attempt to breed (Hagen and Hale, 1974; Chambers & Stacey, 1979).

Honeydew and ants

Often there appears to be a mutual association between conifer lachnids and wood ants. Way (1963) has reviewed this subject in detail. The expansion of large colonies of certain conifer aphids may depend on the ants keeping the colony clean of honeydew deposits.

Ants were found to have no effect on *Cinara pinea* population density or honeydew production, but *C. pini* and *C. nuda* showed enhanced honeydew secretion when ants are present and the ants also protected the aphids from their natural enemies

(Scheurer, 1971). Egger (1973) observed that the ant *Lasius umbratus* attended the colonies of *C. piceae* on *Picea omorika* so effectively that there was no surplus honeydew on the foliage for other insects to feed upon. Czechowski (1975) records ants near aphids chasing away *Coccinella septempunctata* and building protective sheaths of nest material round colonies of aphids. Similar earthen sheaths constructed by ants have often been seen on some seedlings in forest nursery lines in Britain. Some honeydew situations, however, do not appear to be anything like as attractive. Gunkel (1963) reported that *Cinara fresai* was only occasionally visited by ants.

Certain species of conifer lachnids in Central Europe are thought to depend upon ant attendance, and possibly certain aphid species only occur where wood-ants exist (Pintera, 1966; Bradley & Hinks, 1968). In Britain this association appears to be the case with two species, *Cinara kochiana* and *C. stroyani,* but as most of the others exist without ant attendance, for example on recently afforested land, ants may not be essential for survival. In this context it is of considerable interest to note that after *Formica lugubris* was experimentally introduced into a mixed conifer forest in Canada, twenty-one species of *Cinara* were found although only half this number of species had previously been recorded in the province (McNeil *et al,* 1977). The low parasitism in the ant attended colonies is thought to be of significance in allowing larger populations to develop. It would seem possible that larger colonies in Britain could similarly result from ant establishment.

In an Irish woodland, honeydew constituted 75% of the foraging loads of *Formica lugubris* and amounted to an annual nest input of 75 kg (Breen 1978). The annual production from individual trees was measured by Zoebelein (1956) who recorded 70 kg from pine, 30 kg from spruce and 25–30 kg from beech. The actual sugar dry weight arriving at each nest varied from 60–100 kg per year.

4. GLOSSARY OF TERMS USED IN THE LIFE CYCLE OF CONIFER LACHNIDS

Apterous virginopara. Wingless parthenogenetic viviparous female. This morph is the one most frequently encountered because it is the major reproductive component of a colony and it produces several other similar generations throughout the summer months. It is difficult to determine whether it is an adult on morphological features, and probably the only reliable feature is to have evidence that it has given birth.

Alate virginopara. Winged parthenogenetic viviparous female. Numbers of this morph often arise from colonies of apterae. Before their final moult the alatoid nymphs usually move away from the colonies to the outer foliage and shoots. Here they moult into the alate adult and after completing the teneral period (when they expand their wings and harden their exoskeleton) they fly off to colonise another plant usually of the same species. There may be several similar generations during the summer.

Sexuals. These are of two kinds, males and oviparous females.

Ovipara. Apterous female that lays over-wintering eggs. This morph resembles the apterous virginopara but may be somewhat smaller. The tibiae of the hind legs are often darker in the proximal half and sometimes slightly larger in diameter, and if so there may be numerous pseudosensorial pits (or scent plaques) on them (see Fig. 4). The subgenital plate is large and has denser hairs compared with the viviparae. Living adult oviparae of some species can be readily distinguished from virginoparae if they possess a prominent white wax secretion on the posterior segments of the abdomen.

Male. The males are usually smaller than other adults. Some species have wings (alate) others are wingless (apterous). The genitalia on the tip of the abdomen are pigmented and conspicuous (see Fig. 4). There are appreciably more secondary sensoria on the antennae of alate males than apterous ones. The oviparae pair with males to give rise to overwintering eggs.

Eggs. These are smooth and kidney shaped and are attached to plants by an adhesive secretion. The eggs are laid on the host plant (see Fig. 5), the foliage and twigs are most often used, and are deposited either singly or in clusters. Some pine feeding species lay eggs in a row along the needles. Those species feeding on deciduous larches may use old dead cones, bark and even other dead plant material nearby. The eggs turn dark green or blackish soon after laying and usually have a highly polished appearance. In some species, however, the eggs are covered with waxy filaments soon after oviposition by the ovipara (Palmer, 1926). The behaviour of the female in making this covering is described by Day and Edwards (1979) who discuss the possible advantages that this coating affords. Apart from the resistance to wetting, this wax coating may give added frost protection as has been seen in other aphids (Bevan and Carter, 1980).

Fundatrix. A viviparous parthenogenetic female that develops from a fertilised overwintering egg laid by the ovipara. This morph is apterous and tends to have shorter appendages than later females. It is not an active stage and sometimes can be recognised as being the more heavily pigmented individual amongst colonies that occur in the spring.

Holocycle. The complete life cycle represented by the appearance of the above five morphs and an overwintering egg stage. In certain other holocyclic aphids there are recognisable morphs (sexuparae, androparae and gynoparae) that give birth to the sexuals. These do not appear to have been described for the conifer lachnid group.

Anholocyclic. An adjective describing a species or race of aphid that does not produce viable overwintering eggs or sexuals. This may arise on account of climatic or host plant factors (Bevan and Carter, 1975), by its genetical characteristics or chromosome abnormalities (Blackman, 1971).

Footnote on sexual morphs
Eastop (1972) records that samples of oviparae of *Cinara boerneri* that were collected together with males show evident pseudosensoria on their hind tibiae, but in a sample where only oviparae were collected the pseudosensoria were indistinct. He points out that the hind tibiae of the oviparae are slightly thickened and bear numerous pseudosensorial pits in the species with alate males. In support of this *C. acutirostris, C. piceae* and *C. stroyani* which have apterous males, have oviparae that are either devoid of, or have poorly developed, pseudosensoria on their hind tibiae. The presence of the prominent white pericaudal wax-patch on the oviparae occurs in those species known to have apterous males and is lacking in eight of the thirteen species known to have alate males. It would seem that the white wax may be a sufficient visual signal for the apterous males to find oviparae that live in the same colonies whereas the pseudosensoria may emit a pheromone that would enable alate males to home-in on oviparae, as has been suggested for other aphids (Marsh, 1972).

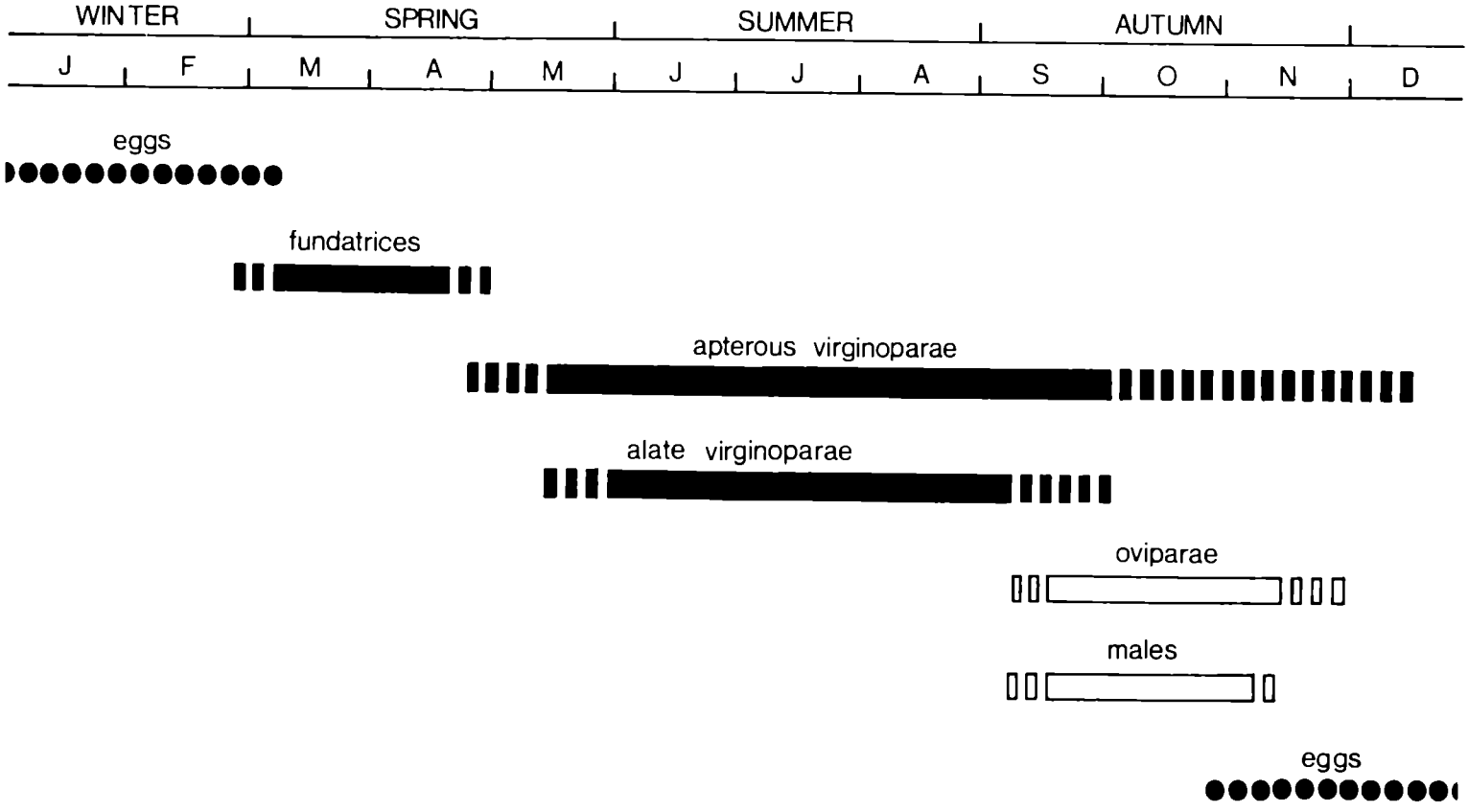

Figure 3. Simplified diagram of the polymorphic life-cycle of a conifer lachnid. The solid lines represent the periods when the morph is most abundant.

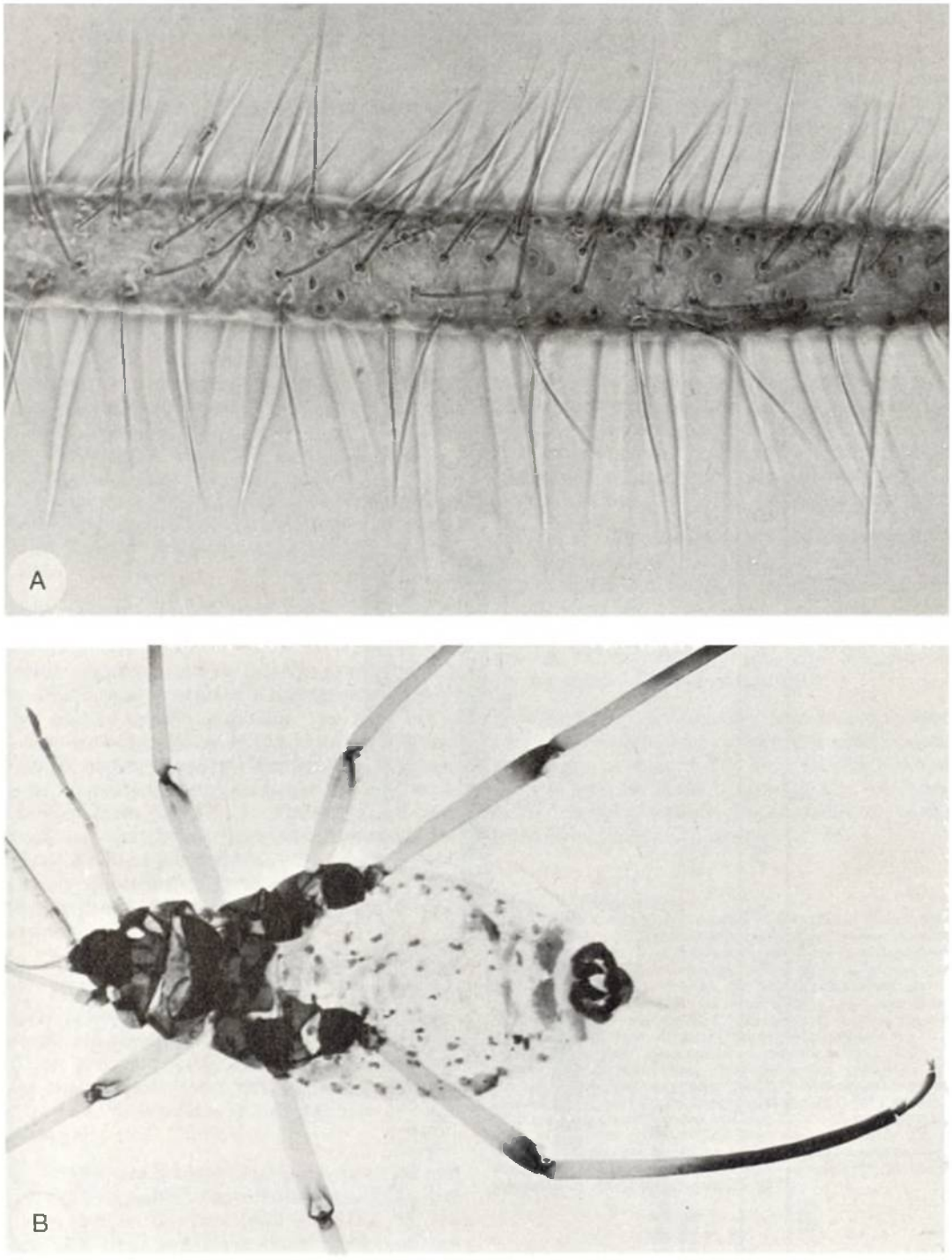

Figure 4.

A. *Cinara cupressi* hind tibia of oviparous female showing secondary 'rhinaria' or scent plaques (phase contrast).

B. *Cinara piceae* apterous male showing heavily pigmented genitalia.

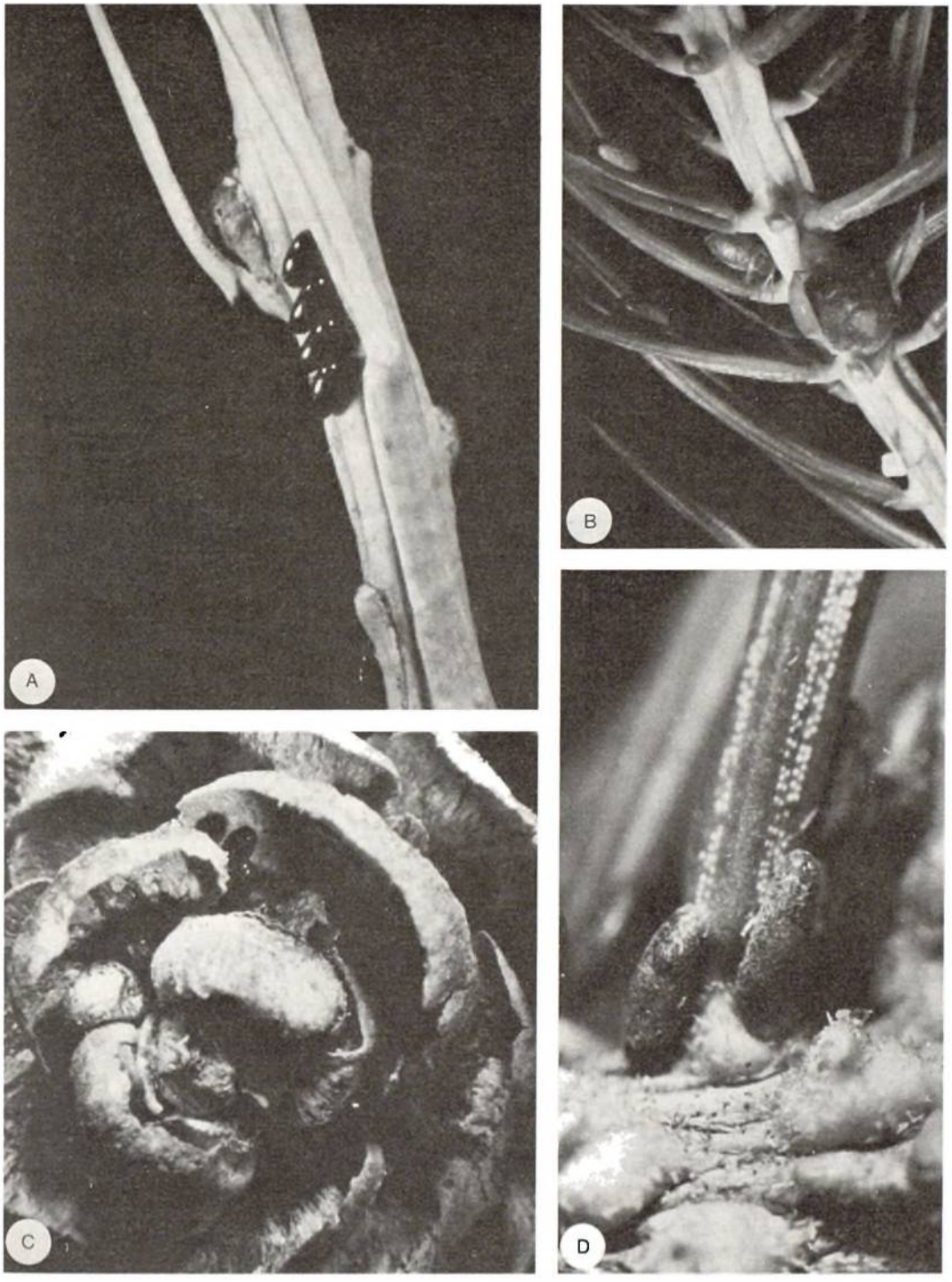

Figure 5. Egg laying sites of conifer lachnids:
A. *C. laricis* on *Larix* shoot, B. *C. pilicornis* on current year's needles, C. *C. kochiana* between old open cone scales, D. *C. piceae* on the base of *Picea* needles.

5. FIELD KEY TO CONIFER LACHNIDAE COMMONLY OCCURRING IN BRITAIN

Conifer lachnids in the main have such fastidious feeding habits that the identity of a colony on a *particular host* can usually be narrowed down to a short list of possibilities. The following key can be followed through with the aid of a x 10 hand lens. There are a few aphid species belonging to other families likely to be found on conifers in Britain; these are mentioned in a footnote under each host-plant section, and at the end of this key.

SPECIES DWELLING ON *ABIES*

1 Large dark brown aphids, wingless adults up to 7.5 mm or slightly more in length; feeding through the bark of the trunk or branches .... *Cinara confinis* (Koch)

— Bright green aphids with two or three paler dorsal longitudinal strips, closely resembling the colour of fir needles where it feeds. Wingless adults up to 5 mm long, feeding on the needles ..... *Cinara pectinatae* (Nördlinger)

Two other aphids occur on *Abies* in Britain: *Mindarus abietinus* Koch can be found in the summer as small colonies of pale grey aphids with copious wax secretion on the soft new growth causing severe needle distortion. *Prociphilus fraxini* (Geoffroy) is less common and is a larger greyish aphid with dark legs found in small colonies on the young roots.

SPECIES DWELLING ON *CEDRUS*

1 Small greyish brown aphids, wingless adults up to 1.5 mm (can only be seen readily with a x 10 hand lens); feeding in small colonies between the scales of the foliated dwarf shoot bases, producing quantities of fine honeydew droplets on the underlying vegetation .... *Cedrobium laportei* Remaudière

— Large brownish aphids, adult females more than 2.5 mm long living in sometimes very large colonies on the bark of stems and branches ... 2.

2 Reddish brown abdomen with two dark longitudinal bands separated by a lightly coloured line. The siphuncular cones are blackish and there may be two black spots between them. The body surface has a mealy wax coating giving a whitish appearance. Legs light brown to yellow and black. Body length 2.5 to 3.0 mm .... *Cinara cedri* Mimeur

— Dark brown or greenish black abdomen with double row of blackish shining speckles and small flecks of fine wax in transverse rows. Legs dark brown sometimes annulated. Body length up to 7.5 mm or more. Sometimes in very large colonies on the bark. Quite active in hot weather, frequently found wandering or falling off the host plants ..... *Cinara confinis* (Koch.)

SPECIES DWELLING ON *CUPRESSUS* AND *THUJA*

Two species *Cinara cupressi* (Buckt.) and *Cinara tujafilina* (del Guercio), occur on certain species of *Cupressus* and *Thuja*. They are both brownish yellow aphids, recorded from the aerial parts of trees where they possibly feed on the foliage as well as the thin barked stem and branches. *C. tujafilina* usually has pale legs with only the tips of the tibiae darker; *C. cupressi* has blackish ends to the "knee" as well.

SPECIES DWELLING ON *JUNIPERUS*

1 Large grey or pinkish aphids, wingless adults up to 3 mm in length; hind tibiae entirely black. Feeding head downwards on new shoots in the axil of the needle and stem of *J. communis* and cultivated varieties in the early summer, moving to the more woody portions later .... *Cinara juniperi* (de Geer)

— Large grey aphid with patches of meal and two anterior broken darker stripes, wingless adults up to 4 mm in length; hind tibae not entirely black. Occurring in dense colonies on small stems yielding honeydew encouraging sooty mould growth. An occasional nursery pest when junipers are grown under protected cultivation..... *Cinara fresai* Blanchard

SPECIES DWELLING ON *LARIX*

1 Large dull greyish brown aphids sometimes with speckled grey wax-like patterning often 5–6 mm in length. Feeds in colonies in bark crevices on large exposed roots, the bases of older branches and on the trunk. Hind tibiae uniformly dark. .. .. *Cinara kochiana* (Börner)

— Medium sized aphids up to 4 mm in length dwelling on the foliated branches of the tree. Speckled body patterns. Hind tibia dark but with paler areas 2

2 Body surface brown with darker blotches, black speckles in four longitudinal rows on the dorsal surface of the abdomen. Hind tibiae dark for up to two thirds of their length .... *Cinara cuneomaculata* (del Guercio)

— Body surface with a grey mealy appearance, distinct black speckles occur all over the dorsal surface of the abdomen, (particularly if the specimens are put in a preservative). Hind tibiae

dark for only half their length .... *Cinara laricis* Hartig

SPECIES DWELLING ON *PICEA*

1 Very large uniformly black aphids, wingless up to 6 mm in length with long legs. Usually existing in very large colonies on the bark of stems and larger diameter branches .... *Cinara piceae* (Panzer)

— Medium sized grey coloured aphids, wingless adults up to 3–4 mm in length, existing in small colonies on shoots and small diameter branches 2

2 Aphids with predominantly black siphuncular cones with some darkly pigmented, patterned areas on the abdomen 3

— Aphids with inconspicuous siphuncular cones and no pigmented-patterned areas on the abdomen 4

3 Greenish grey or brown aphids with black blotchy markings dorsally sometimes with a bronze metallic hue. Wingless forms with very prominent black siphuncular cones which are two diameters or less apart. Winged adults without pictured wings. Occurring in small groups, usually on one year old twigs .... *Cinara pruinosa* (Hartig)

— Brownish grey aphids with a mealy wax covering, occurring in small colonies. The meal tends to be deposited on the twigs near the colony. The siphuncular cones on the wingless adults are three or more diameters apart. Winged adults with distinct pigmentation on their wings..... ..... *Cinara costata* (Zett)

4 Aphids with a dense wax covering. Colours are pale green or pale brown when first put into preservative. In dense colonies, particularly amongst the needles of new shoots but also on the undersides of young lateral shoots. Producing an abundance of honeydew .... *Cinara pilicornis* (Hartig)

— Pale greyish green or buff coloured aphids sometimes dusted with wax. In preservative they are pale olive green or orange brown with two darker green longitudinal stripes on the dorsal surface of the abdomen. They form small colonies on small diameter twigs; attended by ants ..... *Cinara stroyani* (Pašek)

Three species of aphids from other families occur on *Picea* in Britain: *Elatobium abietinum* (Walker) is a small green aphid with red eyes and elongate cornicles commonly found on needles from October to June causing discolouration and defoliation. *Mindarus obliquus* (Cholodkovsky) is a small elongate white aphid living in small colonies and producing flocculent bluish white wax on the new shoot tips of *Picea* during the summer. *Asiphum tremulae* (L) (syn. *Rhizomaria piceae* Hartig) is a whitish or pale yellow aphid occurring in small colonies and making a flocculent white wax secretion on the young roots of trees and seedlings, and can be found throughout the year.

SPECIES DWELLING ON *PINUS*

1 Medium size aphids, wingless females 2.0 to 2.5 mm in length; very elongate shaped abdomen, length more than twice the width; feeding on needles ..... *Eulachnus* spp....2

— Medium to large sized aphids, abdomen egg shaped or circular; length of abdomen not more than twice the width, feeding on needles 4

2 Aphids with a green body colour with little wax meal or filaments by the abdomen; legs with little pigmentation 3

— Aphids with orange-red, brownish or blue-grey body colour and having a white or bluish mealy wax secretion sometimes as a tuft of filaments posteriorly, legs dark .... *Eulachnus bluncki* Börn.

3 Green aphids with pale legs, tibiae with very short inconspicuous hairs .... *Eulachnus brevipilosus* Börn.

— Bright green aphids, body surface dotted with dark scleroites, legs rather pale sometimes with dusky blotches, tibiae with long dark hairs .... *Eulachnus agilis* (Kalt.)

4 Aphids assembling in rows forming compact colonies on the needles. Wingless females not more than 2.5–3.0 mm long. A liberal coating of grey wax particles usually covers the aphids and to some extent the needles where they are feeding, thus disguising the individual shapes of the aphids ..... *Schizolachnus pineti* (F.)

— Medium to large aphids, wingless females 3 to 5 mm in length; not feeding in compact rows on needles, nor secreting an even dense wax covering on their body surfaces . *Cinara* spp...5

5 Large active aphids, wingless females up to 5 mm in length; dark brown to orange brown aphids with small dark siphuncular cones occurring on new shoots and branches but not making large colonies ..... *Cinara pinea* (Mord.)

— Medium sized aphids, wingless females up to 3

mm long, dark grey or greenish with blackish markings and prominent black siphuncular cones. Fresh specimens have a pale grey longitudinal line on the abdomen, ventral surfaces mealy. Occurring on young shoots in spring and on older branches later in the summer .... *Cinara pini* (L.)

Five other pine feeding *Cinara* species have occurred in Britain. Their records are mainly represented by trap catches of the winged forms. Their identification is only reasonably certain when they have been processed for microscopical examination. There is insufficient information at the moment to give adequate descriptions to enable identification in the field. Since more winged than wingless forms have been collected it seems that some of these species probably dwell in parts of the trees less frequently examined, either high up in the crown of older trees or on the roots.

There is one other aphid that occurs on *Pinus* in Britain: *Prociphilus (Stagona) pini* (Burmeister) is a greyish white aphid up to 2 mm long that feeds on the young roots. Small colonies can be found surrounded by white flocculent wax. Frequently found on container grown root systems and in nurseries.

SPECIES DWELLING ON *TSUGA*

Medium sized aphids with a dense covering of wax and with inconspicuous siphuncular cones, forming small dense colonies among the needles of young shoots. Normal host is *Picea* but occasionally found on *Tsuga* .... *Cinara pilicornis* (Hartig)

Two polyphagous aphid species have been found on the new shoots of many conifer genera. These aphids have been particularly noticeable when young plants have been growing in luxuriant greenhouse conditions: *Aphis fabae* Scopoli is a small dull black or greyish green aphid with short black cornicles. *Aulocorthum (Neomyzus) circumflexum* (Buckton) is a small shining pale yellowish green aphid with dull reddish eyes and long thin cornicles; the wingless adults have a prominent dark grey speckled horse-shoe mark on the abdomen.

6. MORPHOLOGICAL KEYS

Key to genera of conifer Lachnidae in Britain – adult females

1 Antennal segments six in number. (Fig 1) 2
— Antennal segments five in number (Fig. 6c). ... . CEDROBIUM Remaudière

2 Apical segment (R_5) of rostrum; (Fig. 7c) acute, dagger shaped (Fig. 8d) length of R_5, always greater than 2 times the base .... *CINARA* Curtis
— Apical segment (R_5) of rostrum short and blunt (Figs. 8A, 8B + 8C) ratio of base to length of R_5 approximately 1:1, but never greater than 1:1.5. 3

3 Body elongate or spindle shaped (Fig. 6B). Hind tarsus I with dorsal hairs. Primary rhinaria without a chitin rim and secondary rhinaria with fused chitin rims, (Fig. 7D). Subapical setae of Ant. VI 3 in number (Figs. 9C, 9D, + 9E). .... *EULACHNUS* Wilson
— Body egg shaped. (Fig. 6A) Hind tarsus I without noticeable hairs (under low magnification). Primary rhinaria with a chitin rim (Fig. 7D) secondary rhinaria also having chitin rims. Subapical setae of Ant. VI 2 or less in number. ..... *SCHIZOLACHNUS* Mordvilko

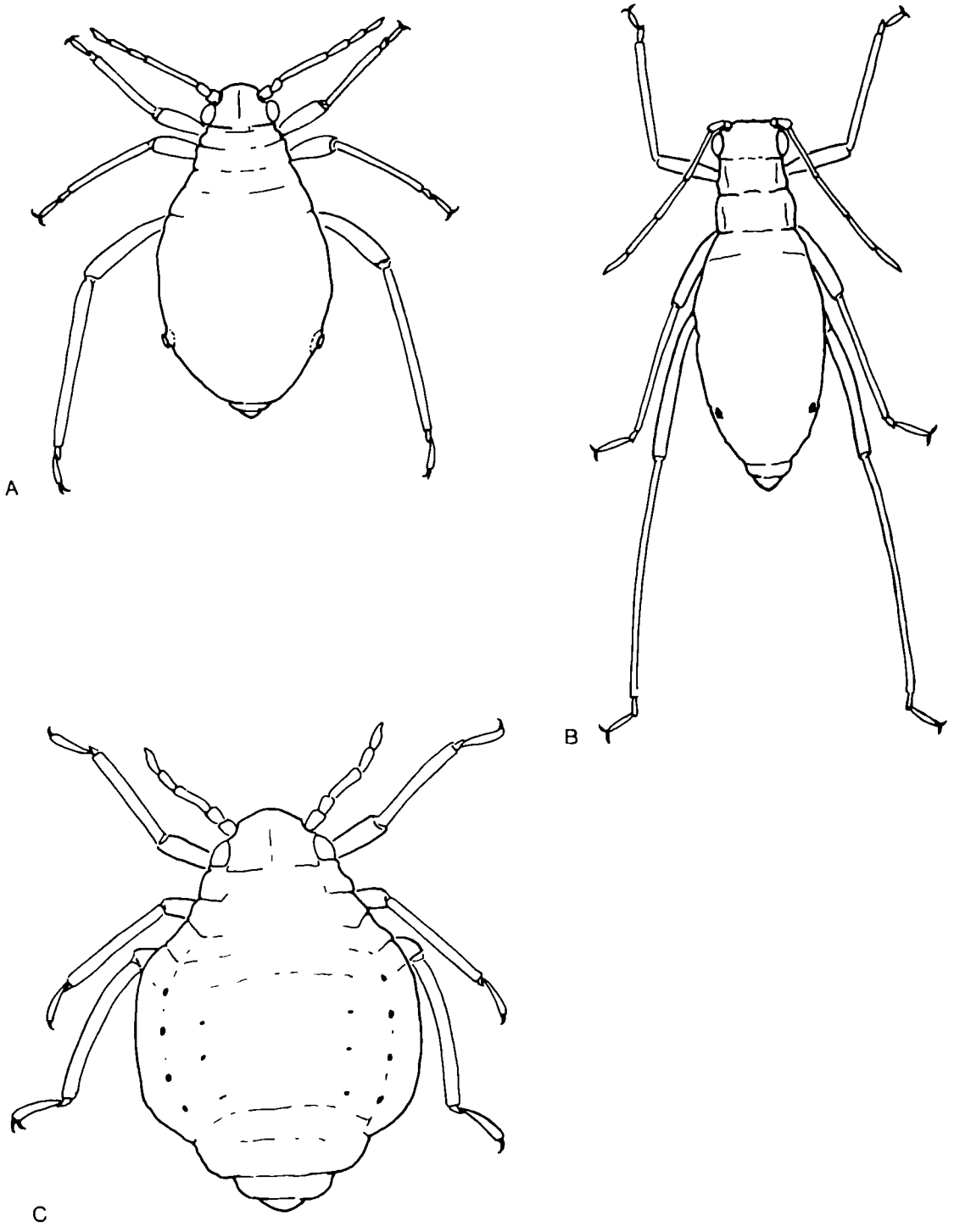

Figure 6. Various body shapes of conifer lachnids:
A. *Schizolachnus pineti*, B. *Eulachnus bluncki*, C. *Cedrobium lapportei*.

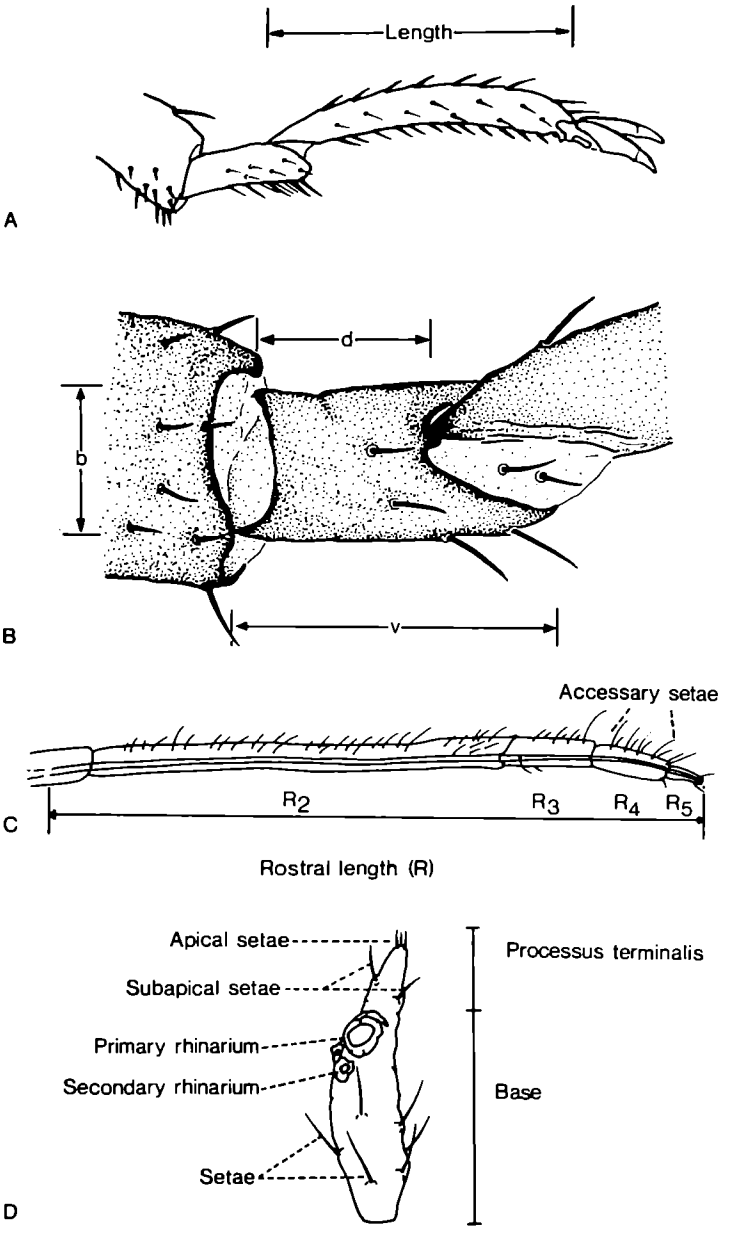

Figure 7. Details of features used in the keys:

A. Tarsal segments I and II of *Cinara cuneomaculata* showing the portion used in length measurements of tarsus II.

B. Tarsus I of *Cinara piceae* showing dorsal length (d), basal width (b) and ventral length (v).

C. Rostrum of *Cinara* sp. showing pigmented zone of the stylet groove used in rostral length measurement (R).

D. Details of antennal segment VI.

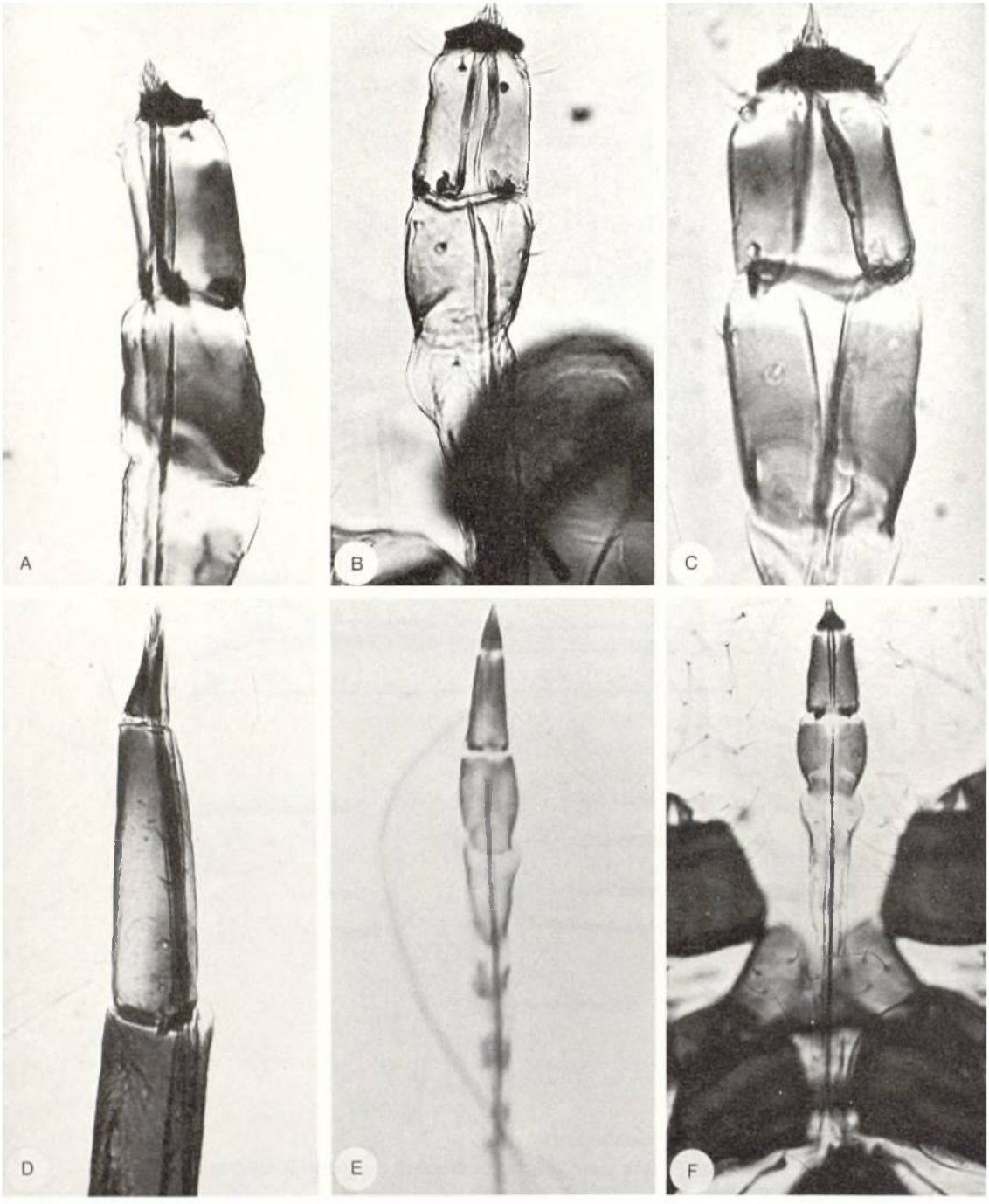

Figure 8. Examples of rostral end segments:
A. *Eulachnus bluncki*, B. *E. agilis*, C. *E. brevipilosus*, D. *Cinara piceae*, E. *Cedrobium lapportei*, F. *Schizolachnus pineti*.

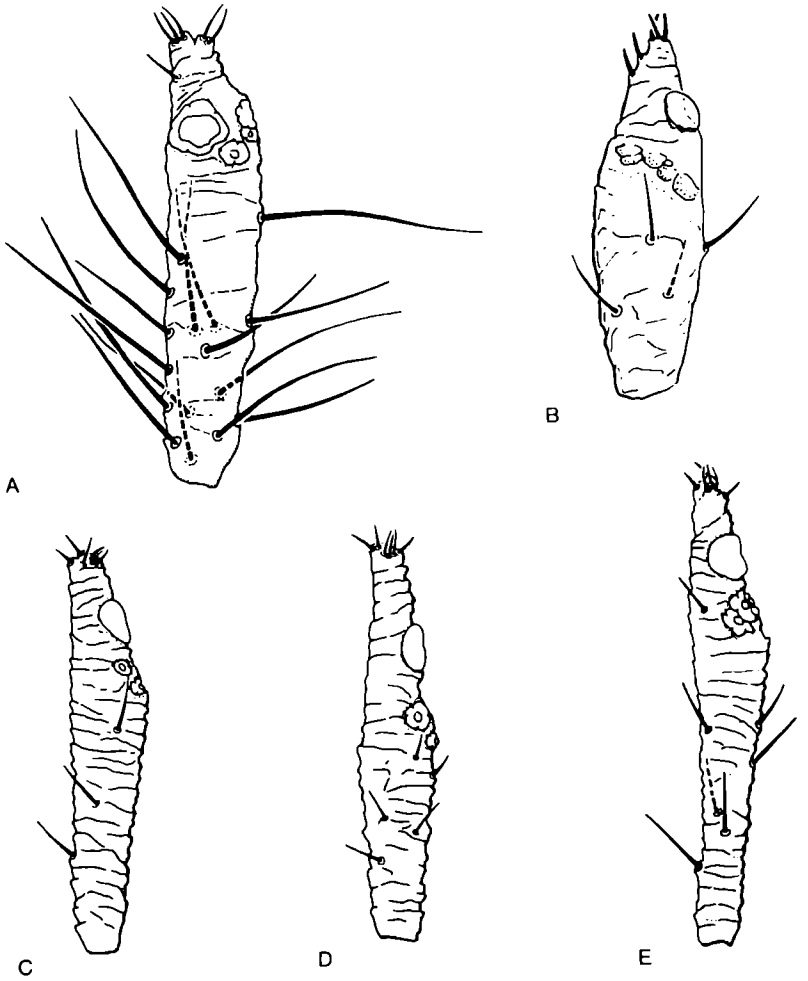

Figure 9. Antennal segment VI of:
A. *Schizolachnus pineti* (This specimen shows the processus terminalis doubled and is slightly aberrant in the abundance of setae on the base), B. *Cedrobium lapportei*, C. *Eulachnus agilis*, D. *E. brevipilosus*, E. *E. bluncki*.

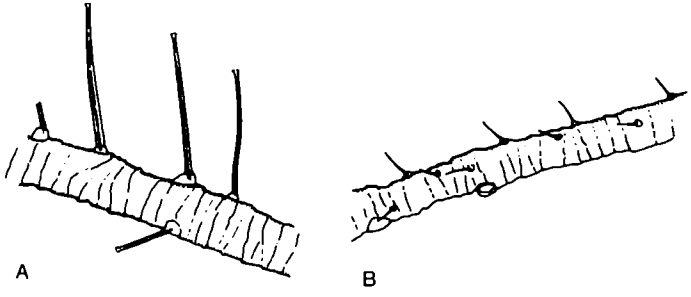

Figure 10. Antennal segment III details of setae:
A. *Eulachnus bluncki* alate ♀, B. *E. brevipilosus* alate ♀.

Key to the species in the genus Eulachnus in Britain – all forms

1 Setae on Ant. III not longer than greatest diameter of that segment; antennal setae spiculate (Fig. 10). Dorsal setae on VIII abdominal tergite numbering 6–14 and bearing strong sub-capitate processes apically. (Fig. 11). Males apterous, rare. ..... *E. brevipilosus* Börner

— Setae on Ant. III distinctly longer than the greatest diameter of that segment; antennal setae mainly sub-capitate (Fig. 10). Dorsal setae on VIII abdominal tergite pointed (Fig. 11). Males alate. 2

2 Length of sub-capitate setae on Ant. III typically more than 2.7 times greatest diameter of that segment. Hind femora and tibiae predominantly pigmented (dark brown), but paler or unpigmented proximally (Fig. 12). Shape of end rostral segment R_5 pentagonal resembling a squat truncated cone on a shouldered sub-rectangular base. Angle from this shoulder to base of stylet tip (Fig. 13) more than 30° (usually 35 to 45°, range 30 to 50°) ..... *E. bluncki* Börner

— Length of sub-capitate setae on Ant. III typically less than 2.7 times greatest diameter of that segment. Hind femora and tibiae predominantly pale distally, typically unpigmented (Fig. 12); but alate forms more variable, occasionally with femora and/or tibiae pigmented (pale brown) for more than distal half; or with round to ovoid scleroite plates at the bases of some or many setae. Shape of end rostral segment R_5 flattened apically, often almost rectangular. Angle from shoulder to the base of the stylet tip (Fig. 13) very shallow—less than 30° (usually 15–25°, range 5–28°) ..... *E. agilis* (Kaltenbach)

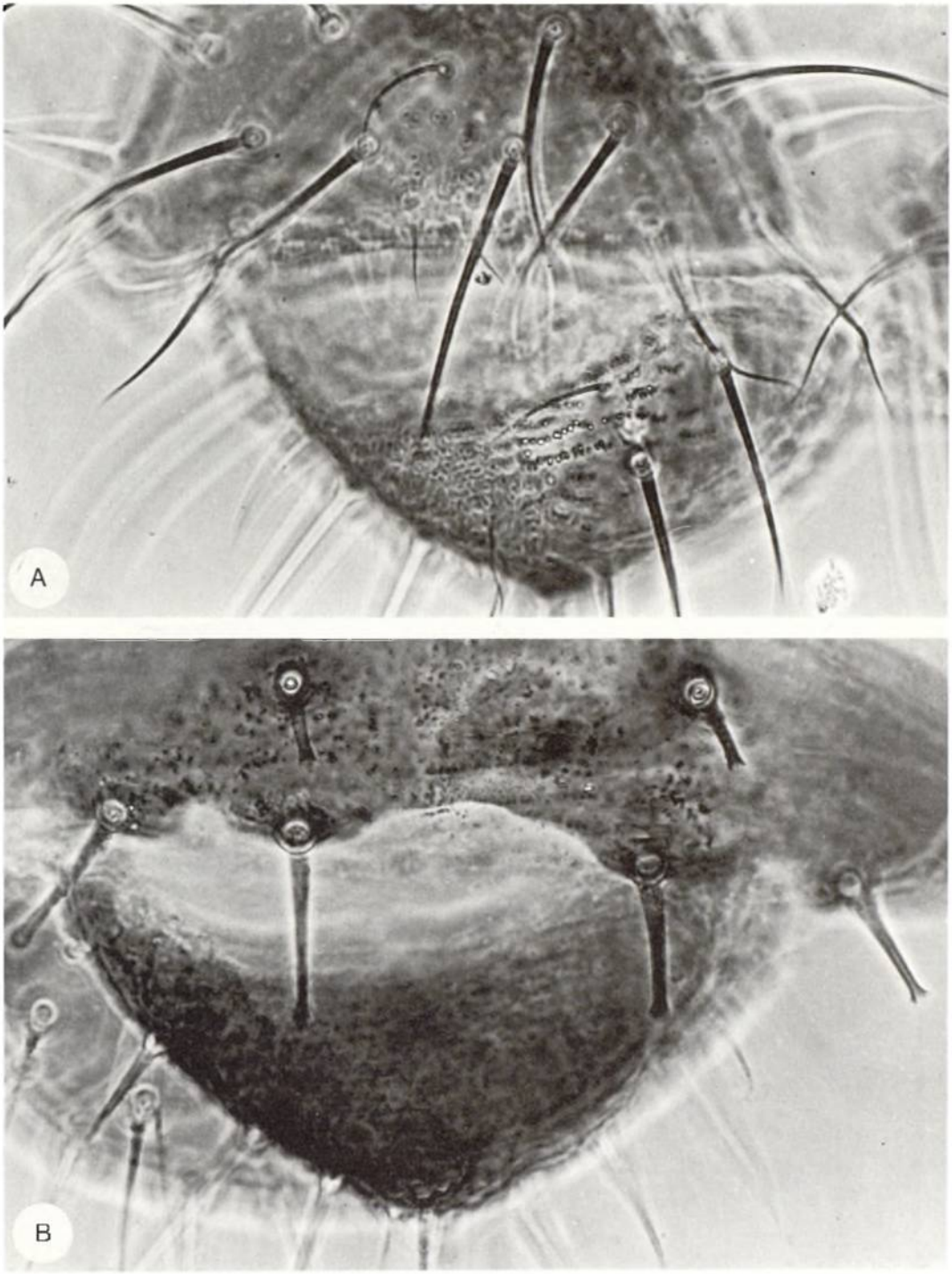

Figure 11. Setae in caudal region of:
A. *Eulachnus bluncki*, B. *E. brevipilosus*.

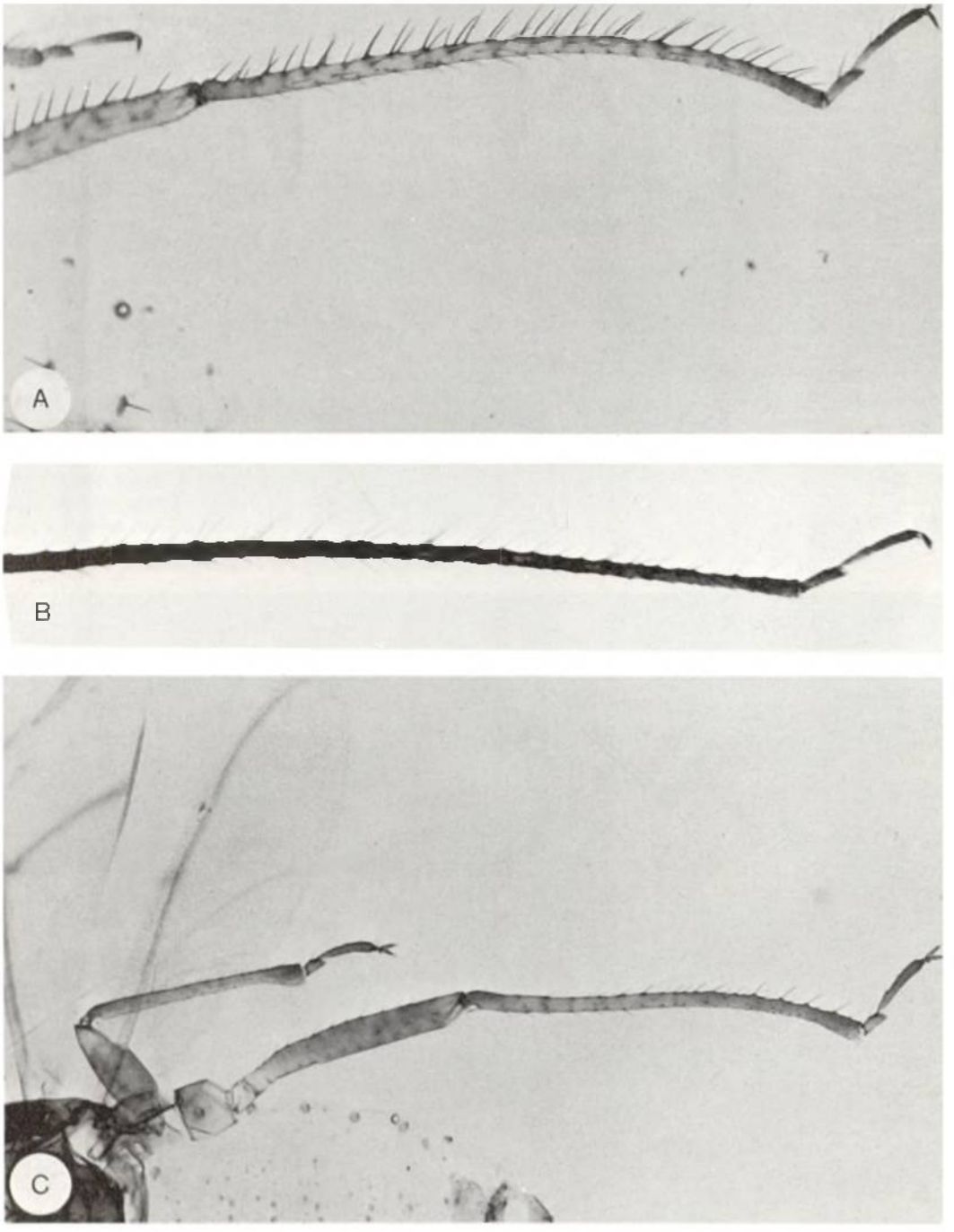

Figure 12. Comparison of setae and pigmentation of the hind tibiae in *Eulachnus* species: A. *E. agilis*, B. *E. bluncki*, C. *E. brevipilosus*.

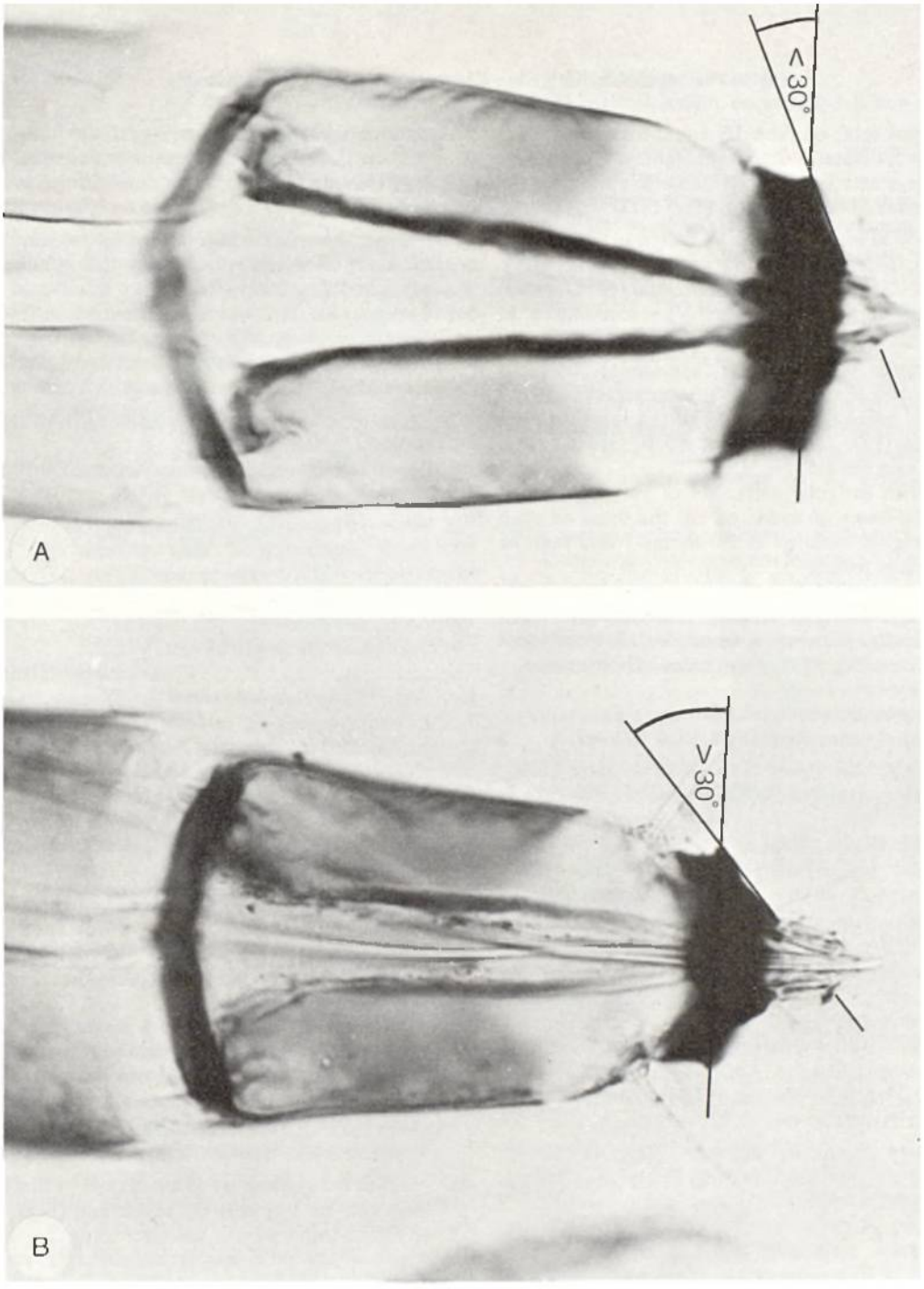

Figure 13. Comparison of shapes of end rostral segment (R_5):
A. *Eulachnus agilis*, B. *E. bluncki*.

Key to the species in the genus Cinara in Britain – adult females

1 Longest seta, on Ant. III equal to, or less than, greatest diameter of that segment. (Fig. 14C). .2
— Longest seta on Ant. III exceeding the greatest diameter of that segment. (Fig. 14D). 3

2 Subapical setae on Ant. VI (often in the form of blunt spines) three to four in number (Fig. 14A). ..... *Cinara cuneomaculata* (del Guercio)
— Subapical setae on Ant. VI exceeding 4 in number (Fig. 14B). 7

3 Abdomen with irregular, sometimes confluent scleroites of varying sizes (most exceeding 50 μ) at the bases of some or all of the setae on each tergite (Fig. 15C); ratio of d : b, tarsus I (Fig. 7B); exceeds 1.5 (Fig. 15A). 4
— (a) With irregular scleroites of varying sizes at the bases of some, or all, the setae on each tergite; ratio of d : b tarsus I less than or equal to 1.5;
or
(b) All abdominal tergites with rounded, often circular, scleroites of similar diameter, not exceeding 50 μ at the bases of most setae;
or
(c) Scleroites totally absent or present on only a few tergites (typically I–III & VII–VIII) ...5

4 R_4 (Fig. 7C) more than twice as long as R_5; accessory setae on R_4 6–8 in number, typically 7. ..... *Cinara pectinatae* (Nörd.)
— Length of R_4 equal to or less than twice R_5; accessory setae on R_4 4–6 in number, typically 5. ..... *Cinara pinea* (Mord.)

5 Length of whole rostrum (Fig. 7C) exceeding 2.4 mm and longest setae on Ant. III equalling or exceeding three times the basal diameter of that segment. ..... *Cinara confinis* (Koch)
— Without the above characteristics combined. Length of whole rostrum less than 2.4 mm; ratio of longest setae on Ant. III: basal diameter of Ant. III may be greater or less than three times, according to species. 6

6 Primary rhinarium on Ant. VI with distinct chitin rim Processus terminalis typically with 4, rarely with 3 subapical setae. 9
— Primary rhinaria on Ant. VI without chitin rim. Processus terminalis typically bearing only 3, rarely 4 subapical setae, (Fig. 16B). Hairs on body and appendages very long (Fig. 17), longest setae on Ant. III at least 3 times basal diameter of that segment. 10

7 R_4 with 4 longitudinal, parallel, rows of setae numbering 21 to 34 *in toto* (Fig. 16A). .... *Cinara kochiana* (Börn.)
— R_4 with only 2 rows of setae numbering 6 to 20 *in toto* (Fig. 18A). 8

8 Length of whole rostum exceeding 2.4 mm; ratio of d : b of tarsus I exceeding 1.7. Number of setae on R_4 typically 10 to 20. .... *Cinara piceae* (Panz.)
— Length of whole rostum less than 2.4 mm; ratio of d : b of tarsus I distinctly less than 1.7. No. of setae on R_4 typically less than 10. 14

9 Blunt setae on processus terminalis (Fig. 18B) 5 or more in number. 13
— Blunt setae on processus terminalis 3–4 in number. 15

10 Setae on base Ant. VI numbering 8 or less; hind tibiae pigmented at least at base and apex, unpigmented or paler in middle (Fig. 17); rostral length typically less than 1.1 mm; accessory setae on R_4 not exceeding 5 in number; Ant. III more than twice the length of Ant. VI. .... *Cinara cupressi* (Buckt.)
— Ant. VI typically with more than 8 setae on base; if bearing only 8 setae and hind tibiae are pigmented at base and apex, as above, then rostrum exceeds 1.1 mm and R_4 bears more than 5 accessory setae (Fig. 19B). If not, hind tibiae is entirely pigmented or dark at apex only (Fig. 20). Ratio of Ant. VI : Ant. III less than, or little more than, 2. 11

11 Hind tibiae entirely pigmented, brown to dark-brown, often slightly paler towards apex (Fig. 20) and rostrum shorter than 1.1 mm, if marginally longer, R_4 bearing less than 5 accessory setae. (Fig. 19C). .... *Cinara juniperi* (de Geer)
— Hind tibiae paler or unpigmented proximally, if tibiae are entirely dark brown or black then rostral length is typically in excess of 1.1 mm. In specimens where it is marginally less, R_4 bears 5 or more accessory setae. (Fig. 19B). 12

12 Hind tibiae pigmented (dark brown to black) at base and apex or entirely pigmented (Figs. 20B & C). Length of R_5 not exceeding 2.5 times length of the processus terminalis. (p.t. usually greater than 40 μ). ..... *Cinara fresai* Blanch.
— Hind tibiae typically dark only towards apex (Fig. 20D), occasionally with darker pigmentation at base; length of R_5 exceeding 2.5 times the length of processus terminalis (which is usually

less than 40 μ). .... *Cinara tujafilina* (del Guercio)

13 Ratio of d : b of tarsus I (Fig. 7B) exceeding 1.5; setae on processus terminalis 5–8. (Fig. 18B). .. .. *Cinara brauni* Börn.

— Ratio of d : b of Tarsus I less than 1.5. 14

14 Length of R_5 exceeding 3 times its own greatest width. Processus terminalis with 5 blunt setae usually on one antennae only, the other with 4. (This is a common aberration, see couplet 19 for typical form). ..... *Cinara acutirostris* H.R.L.

— Length of R_5 less than 3 times its own greatest width. Processus terminalis (on both antennae) with 5 or more blunt setae (Fig. 27E) .... *Cinara escherichi* (Börn.)

15 Abdomen with irregular, sometimes confluent scleroites at the bases of at least some of the hairs on every tergite (Fig. 21B). Ratio of lengths of R_5 : basal width of R_5 not exceeding 2.45. ..... *Cinara laricis* (Hartig)

— Irregular scleroites absent or occurring on a few tergites only, but rarely on Abd. IV–V (Fig. 21A). Ratio of length R_5 : basal width of R_5 exceeding 2.45. 16

16 Length of hind tarsus II exceeding the greatest pigmented diameter of the siphuncular cones; if it is the same or a little shorter then the ratio of tarsus II : tarsus I (ventral length) exceeds 2.6; length of rostrum less than 2 mm. 17

— Length of hind tarsus II not exceeding greatest pigmented diameter of siphuncular cones; if it is the same or slightly longer then ratio of tarsus II : tarsus I (ventral length) is less than 2.6; length of rostrum 1.2–2.5 mm. 18

17 R_4 with four accessory setae; if more than this (5–7), then ratio of R_{1+2} : R_4 not exceeding 4.6. ..... *Cinara pilicornis* (Hartig)

— R_4 with 8 or 9 accessory setae; if less than this (5–7), then ratio of R_{1+2} : R_4 exceeds 4.6. .... *Cinara stroyani* Pašek

18 Ratio of d:b tarsus I exceeding 1.5. Length of whole rostrum not exceeding 1.9 mm; secondary setae on R_4 typically 7–8 in number and longest setae on Ant. III exceeding 2.8 times basal diameter of that segment. . *Cinara cedri* Mimeur

— Ratio of d:b tarsus I (Fig. 7B) typically less than 1.5 and not with above combination of characters. If d:b exceeds 1.5 then with at least one of the following characters:
(a) rostral length exceeding 1.9 mm *(schimitscheki),*
(b) secondary setae on R_4 typically 4–6 in number *(pinihabitans),*
(c) longest setae on Ant. III less than 2.8 times the basal diameter of that segment *(pini).* 19

19 Blunt setae on processus terminalis 3 or 4 in number; (Fig. 25B) ratio of rostral length : R_{4+5} exceeding 5.8; length of R_5 exceeding its own greatest width by more than 2.8 times, and length of rostrum exceeding 1.6 mm. .... *Cinara acutirostris* H.R.L.

— Setae on processus terminalis 4 in number and without all the above characters combined. In such cases where two of the last three characters occur, accessory setae on R_4 exceeding 8 in number. 20

20 Length of whole rostrum exceeding 1.9 mm. .21

— Length of whole rostrum less than 1.9 mm. ...22

21 Tarsus II not exceeding 1.9 times the ventral length of tarsus I; dorsal length of tarsus I more than 1.5 times basal length (Fig. 7B); accessory setae on R_4 exceeding 8 (Fig. 18A) .... *Cinara schimitscheki* Börn.

— Tarsus II exceeding 1.9 times the ventral length of tarsus I; dorsal length of tarsus I less than 1.5 times the basal length; accessory setae on R_4 not exceeding 8 in number. .... *Cinara pruinosa* (Hartig)

22 Ratio of rostral length : R_{4+5} less than 0.5; basal length of tarsus I distinctly less than 1.5 times the dorsal length; R_5 longer than 3.5 times its own basal diameter. .... *Cinara costata* (Zett.)

— Ratio of rostral length: R_{4+5} exceeding 0.5; basal diameter of tarsus I distinctly more than 1.5 times (ie up to 1.3) that of the dorsal length (Fig. 7B). Length of R_5 less than 3.5 times its own basal diameter. 23

23 Ratio of hind tarsus I and II: R_{4+5} exceeding 1.5; longest setae on Ant. III exceeding 2.8 times the basal diameter of that segment. .... *Cinara pinihabitans* (Mord.)

— Ratio of tarsus I and II : R_{4+5} less than 1.5; longest setae on Ant. III less than 2.8 times the basal diameter of that segment. .... *Cinara pini* (L.)

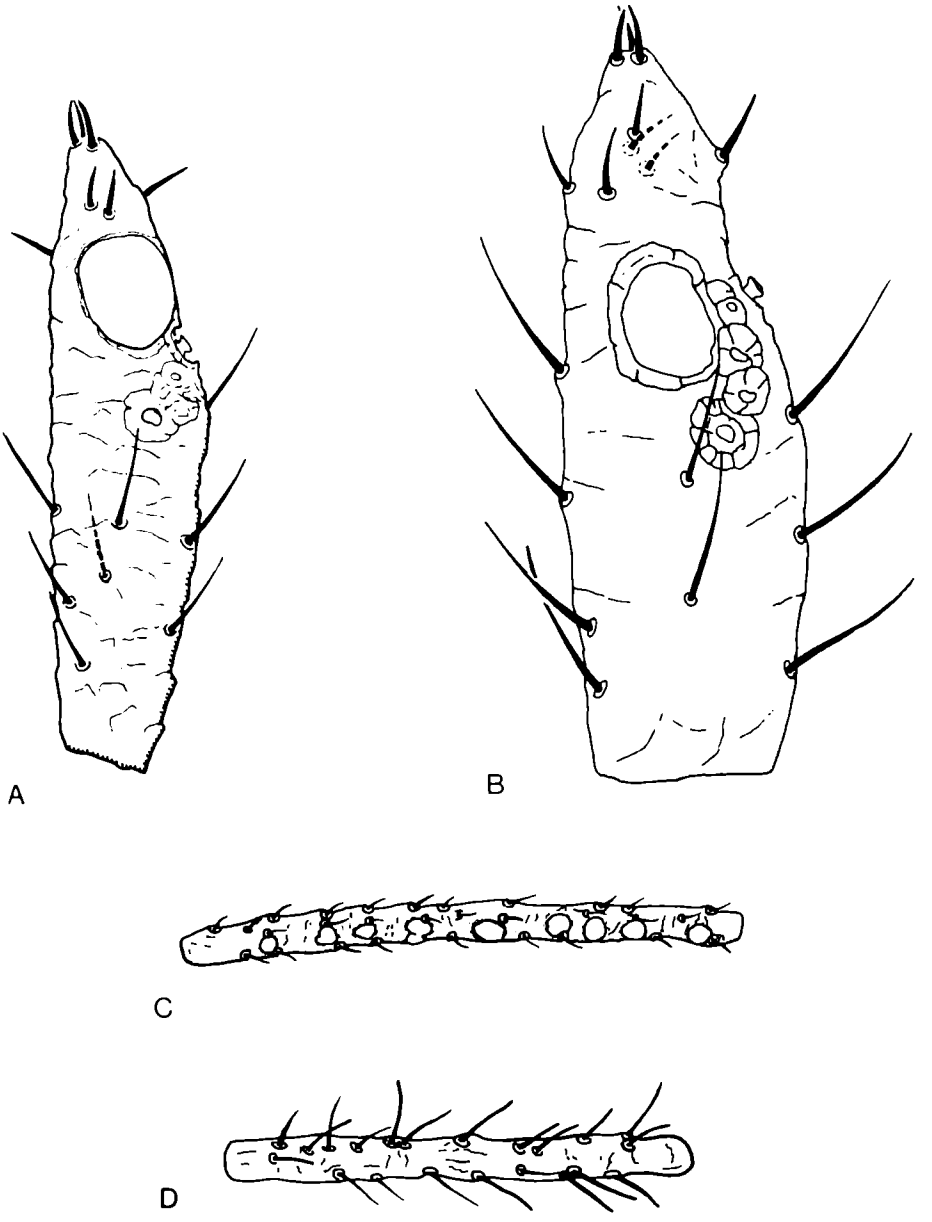

Figure 14. *Cinara cuneomaculata* alate ♀: A. Antennal segment VI, C. Antennal segment III.
Cinara kochiana apterous ♀: B. Antennal segment VI, D. Antennal segment III.

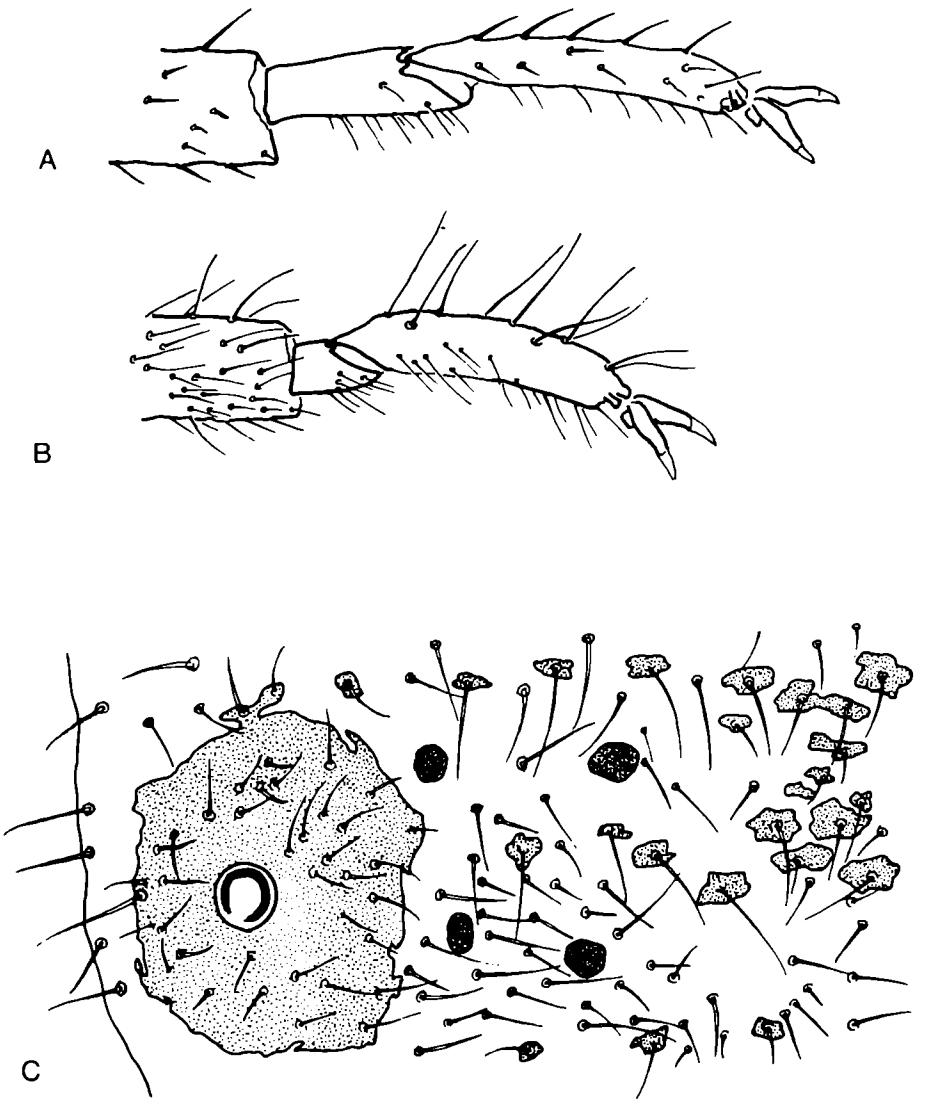

Figure 15. Tarsal segments I and II:
A. *Cinara pinea* apterous ♀, B. *Cinara costata* apterous ♀, C. Dorsal abdominal scleroites of *Cinara pinea* apterous ♀.

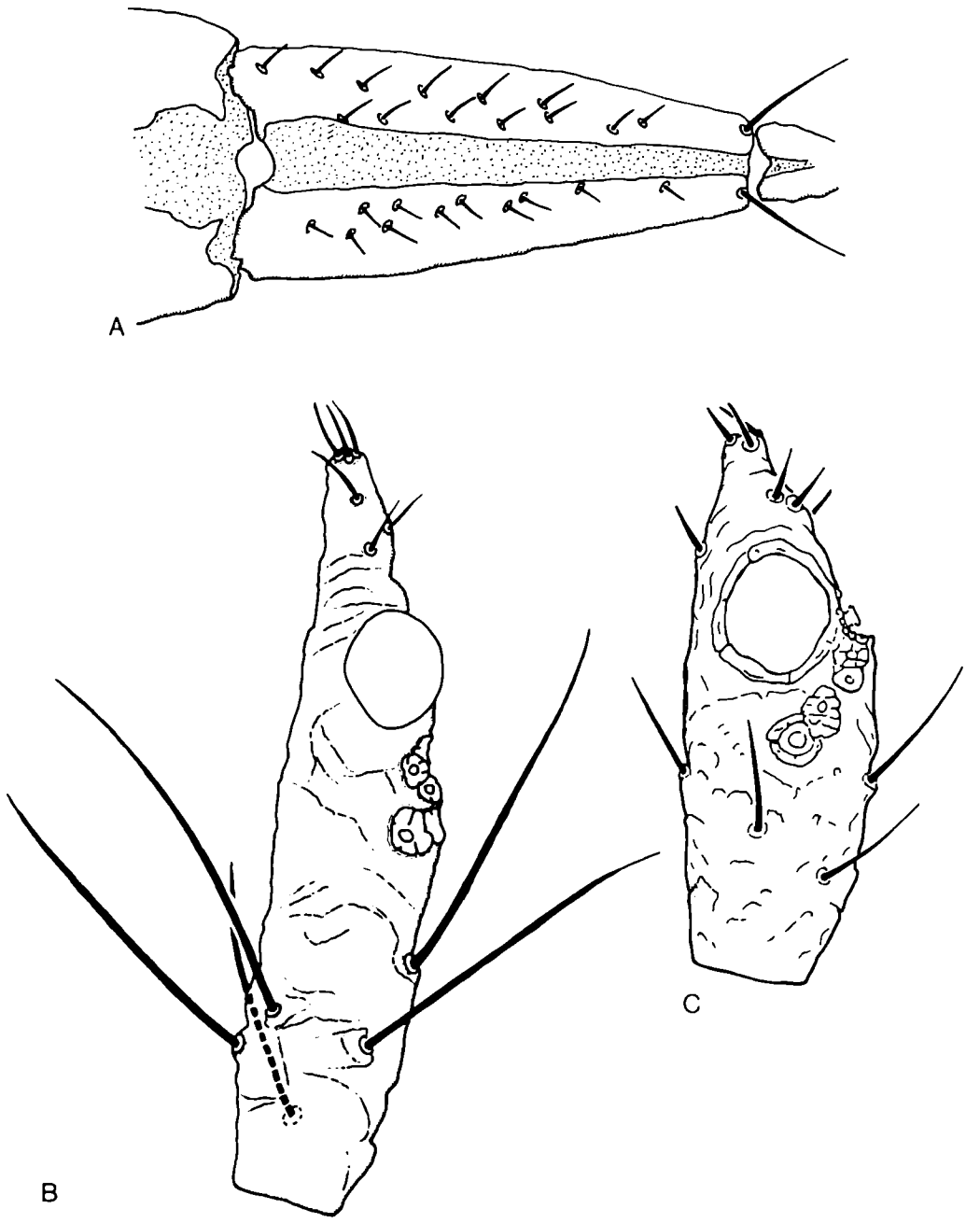

Figure 16.
A. Rostral segment (R_4) of *Cinara kochiana* apterous ♀ with double rows of accessory setae, B. Antennal segment VI of *Cinara cupressi* alate ♀, C. Antennal segment VI of *Cinara laricis* alate ♀.

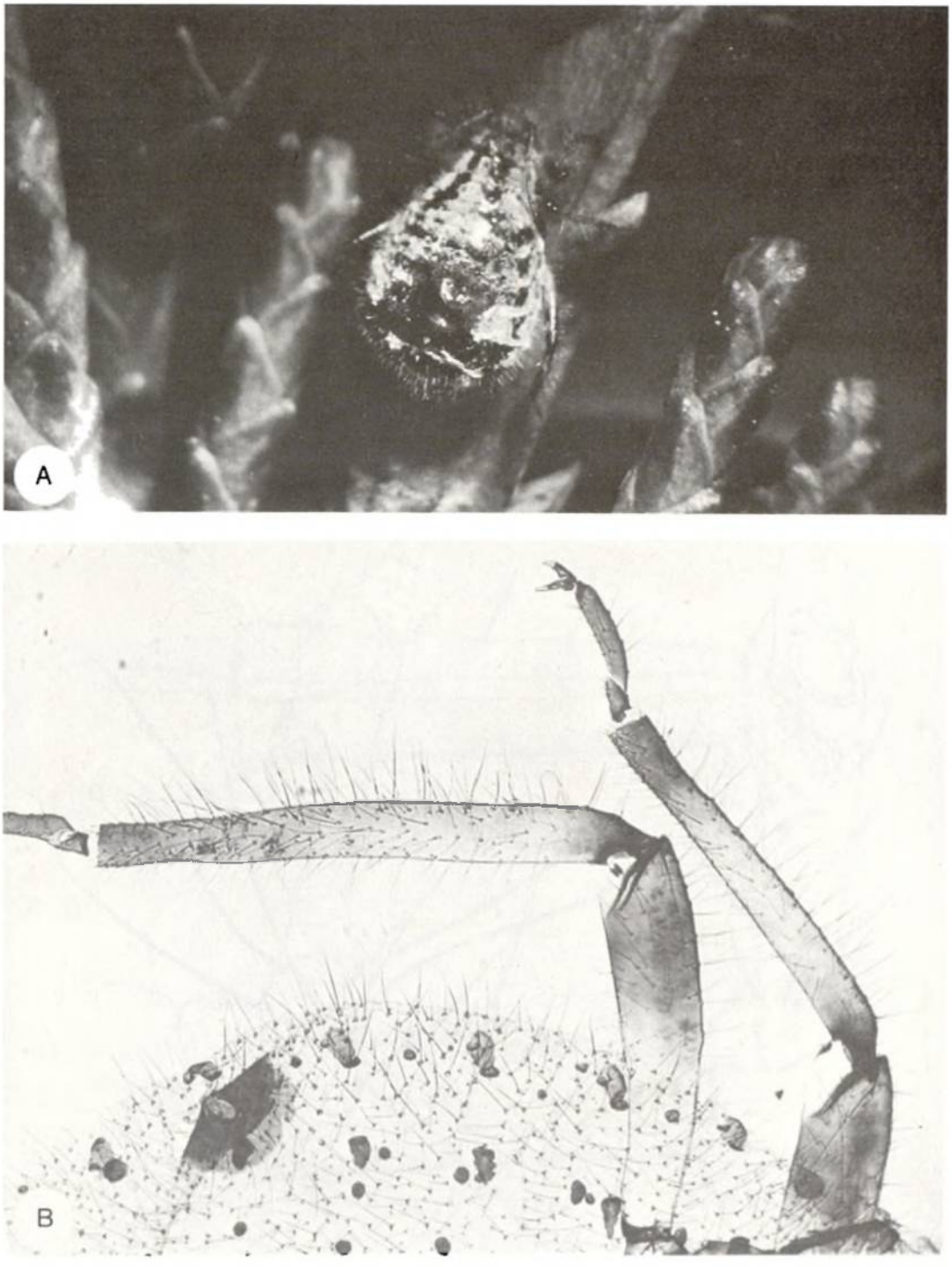

Figure 17. *Cinara cupressi:*
A. Apterous female, B. Portion of abdomen and hind tibia of a cleared specimen.

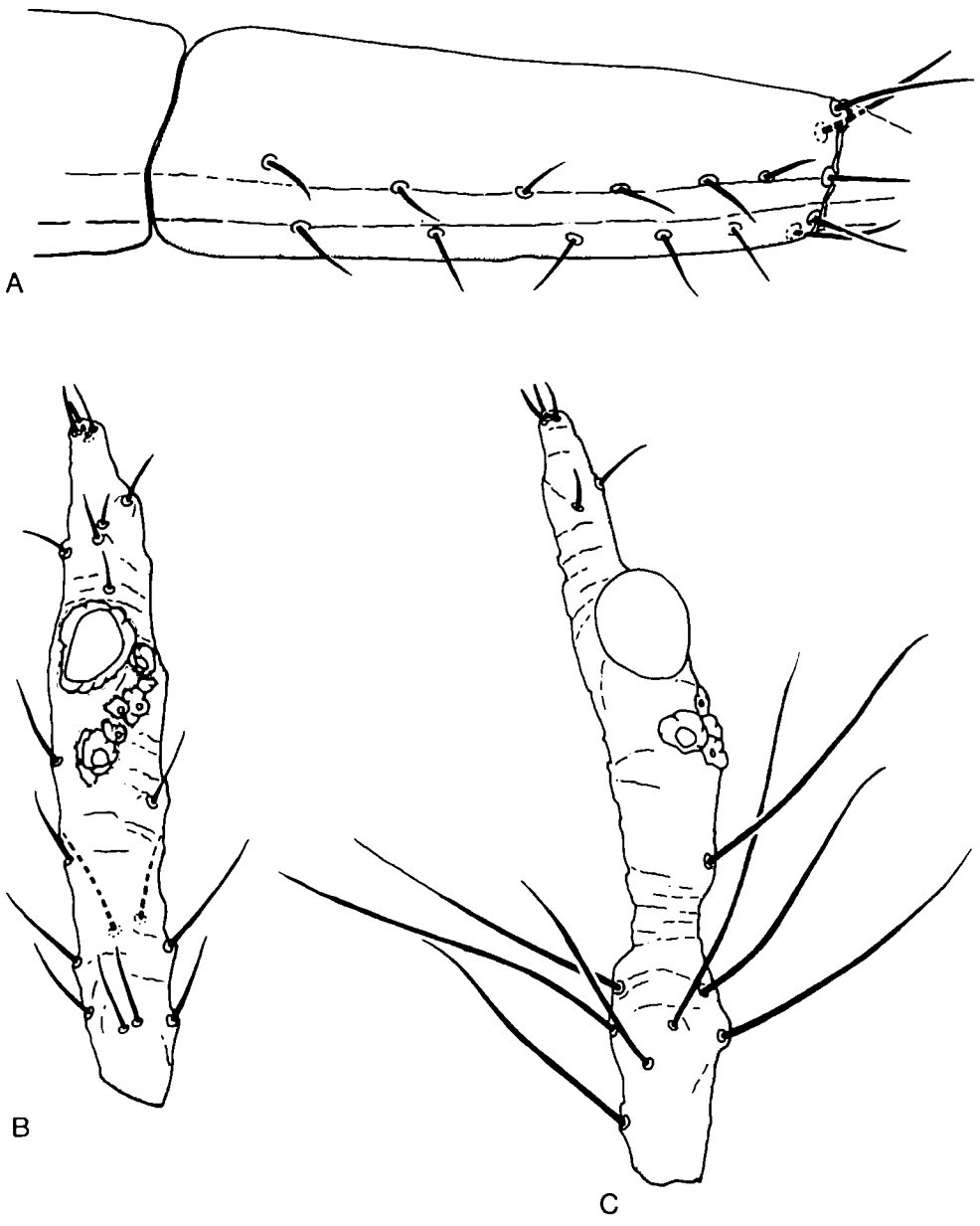

Figure 18.
A. *Cinara piceae*, rostral segment (R_4) alate ♀, B. *C. brauni* antennal segment VI alate ♀, *C. C. juniperi* antennal segment VI alate ♀.

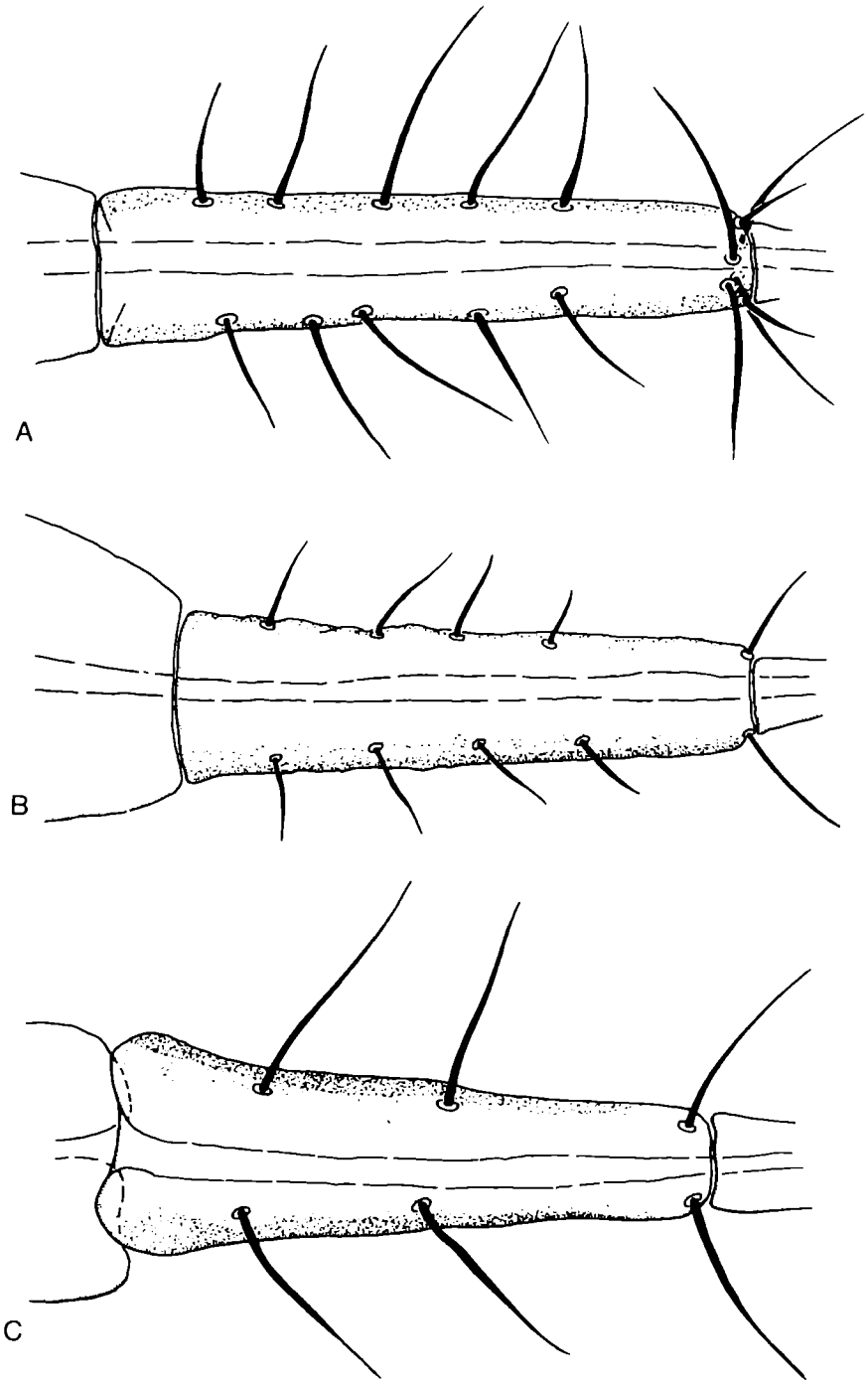

Figure 19. Rostral segments (R_4):
A. *Cinara schimitscheki* alate ♀, B. *C. fresai* alate ♀, C. *C. juniperi* apterous ♀.

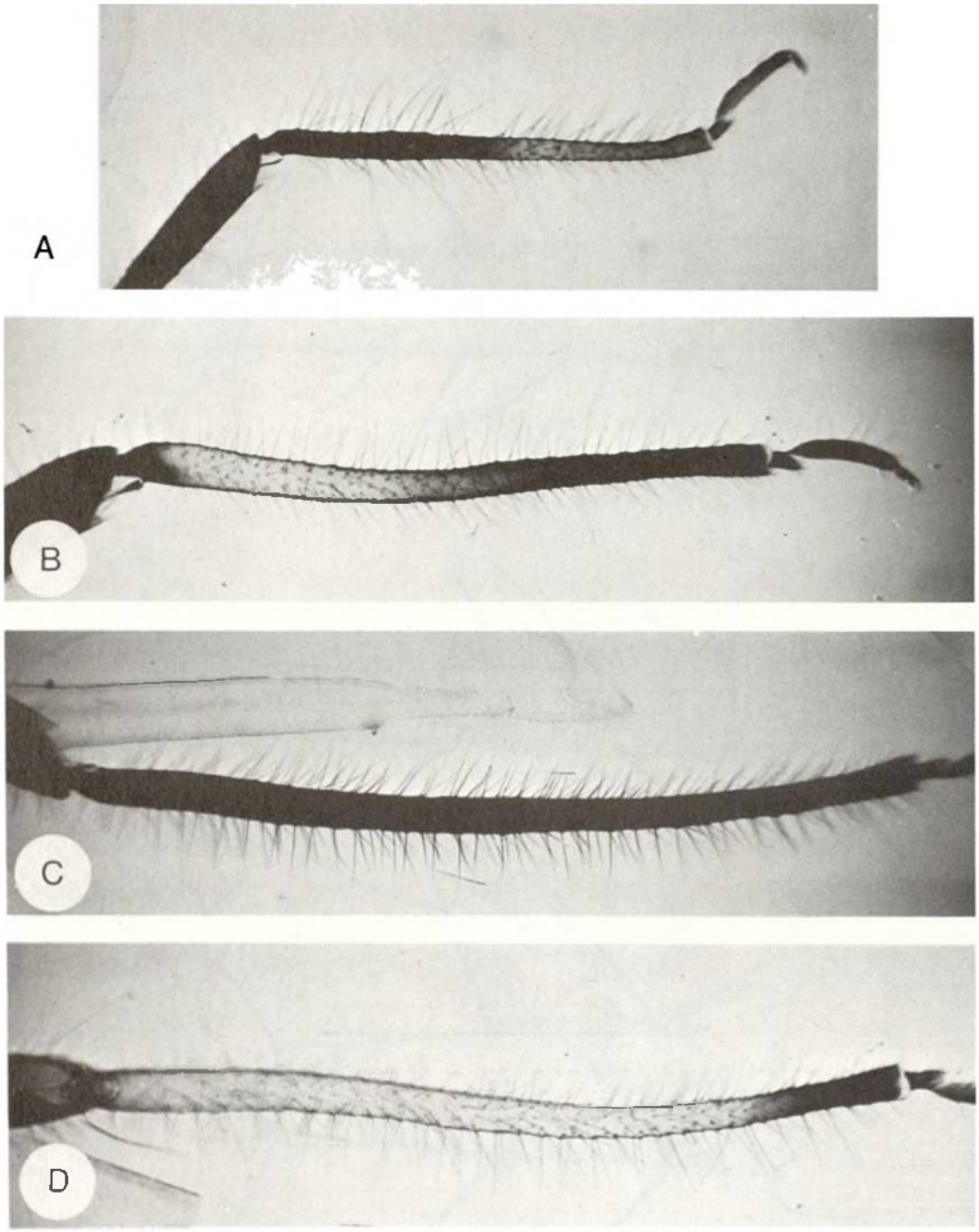

Figure 20. Comparative pigmentation of the hind tibiae of closely related species:
A. *Cinara juniperi*, B. *C. fresai* – partially pigmented, C. *C. fresai* – totally pigmented,
D. *C. tujafilina*.

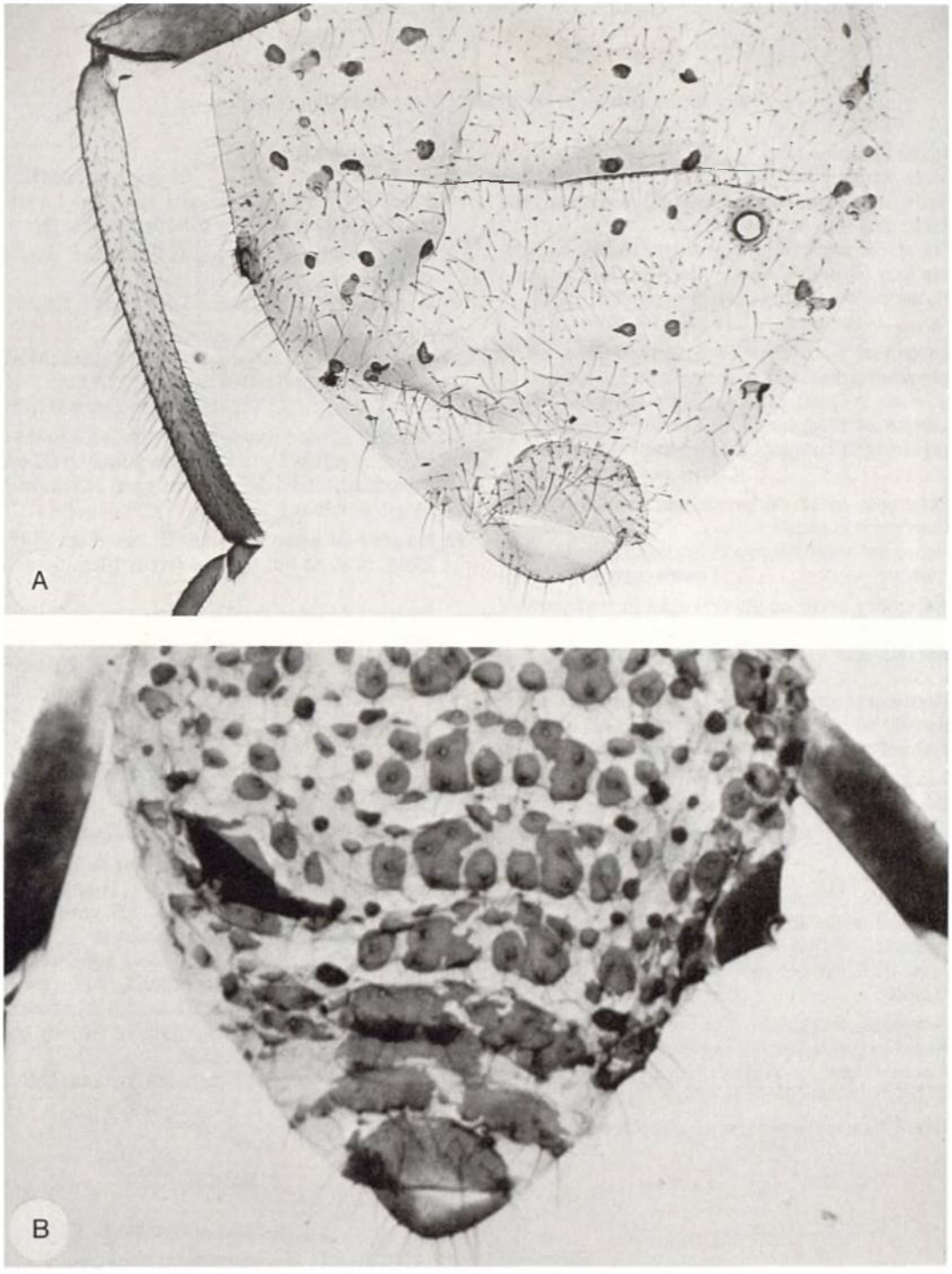

Figure 21. Differences in abdominal sclerotisation of cleared specimens:
A. *Cinara pilicornis*, B. *C. laricis*.

Key to the species in the genus Cinara in Britain – males

1 Males apterous 2
— Males alate 4
2 Subapical setae on processus terminalis not exceeding four in number 3
— Subapical setae on processus terminalis exceeding four (5–8) in number, and accessory setae on R_4 exceeding twelve (13–16) in number ..... *Cinara piceae* (Panz.)
3 Length of hind tarsus II more than the greatest pigmented diameter of the siphuncular cones. ..... *Cinara stroyani* (Pašek)
— Length of hind tarsus II less than the greatest pigmented diameter of the siphuncular cones ..... *Cinara acutirostris* H.R.L.
4 Subapical setae on processus terminalis more than three in number 5
— Subapical setae on processus terminalis three in number ..... *Cinara cupressi* (Buckt.)
5 Accessory setae on R_4 arranged in four parallel rows, typically with 7–8 per row (Fig. 16A), and not less than 20 setae in total ..... *Cinara kochiana* (Börn.)
— Accessory setae on R_4 in two parallel rows, usually with 2–8 setae per row (Figs. 22A + B), and not more than 18 setae in total 6
6 Length of longest seta on Ant. III not exceeding the greatest diameter of that segment; if marginally longer than greatest diameter, then dorsal length of hind tarsus I exceeds 1.5 times basal length ..... *Cinara cuneomaculata* (del Guercio)
— Longest seta on Ant. III exceeding greatest diameter of that segment and dorsal length of hind tarsus I, not exceeding 1.5 times its basal length 7
7 Accessory setae on R_4 nine or more in number . 8
— Accessory setae on R_4 numbering less than nine. Longest seta on Ant. III rarely exceeding 2.8 times the basal diameter of that segment 9
8 Basal diam. of hind tarsus I exceeds 1.4 times the dorsal length (Fig. 7B). ..... *Cinara confinis* (Koch)
— Basal diam. of hind tarsus I less than 1.4 times the dorsal length ..... *Cinara pruinosa* (Hartig)
9 Ratio of d:b of hind tarsus I is more than 1.5 (Fig. 7B). 10
— Ratio of d:b of hind tarsus I is less than 1.5 ... 11
10 R_4 with 4–6 accessory setae. ..... *Cinara pinea* (Mord.)
— R_4 with 7–8 accessory setae (Fig. 23A). ..... *Cinara pectinatae* (Nörd.)
11 Length of hind tarsus II more than 3.3 times the length of tarsus I ..... *Cinara pilicornis* (Hartig)
— Length of hind tarsus II less than 3.3 times the length of tarsus I 12
12 Number of setae on Ant. II less than 10 (Fig. 23B); ratio of b:d of hind tarsus I less than 1.5. 13
— Number of setae on Ant. II greater than 10; b:d hind tarsus I is greater than 1.5. ..... *Cinara costata* (Zett.)
13 Ratio of hind tarsus I + II : R_{4+5} greater than 1.5; accessory setae on R_4 numbering 4–6 (Fig. 22A). 14
— Ratio of hind tarsus I + II : R_{4+5} less than 1.5; accessory setae on R_4 typically 7–8, only rarely with fewer or more (range 6–10) ..... *Cinara pini* (L.)
14 Accessory setae on R_4 numbering 5–8, typically six, ratio of length Ant. III : length R_3 not exceeding 3.2; length of Ant. III typically less than two times the length of tarsus II ..... *Cinara laricis* (Hartig)
— Accessory setae on R_4 numbering 4–6, typically 4–5; ratio of length Ant. III: length R_3 exceeding 3.2; length of Ant. III typically two or more times the length of tarsus II ..... *Cinara pinihabitans* (Mord.)

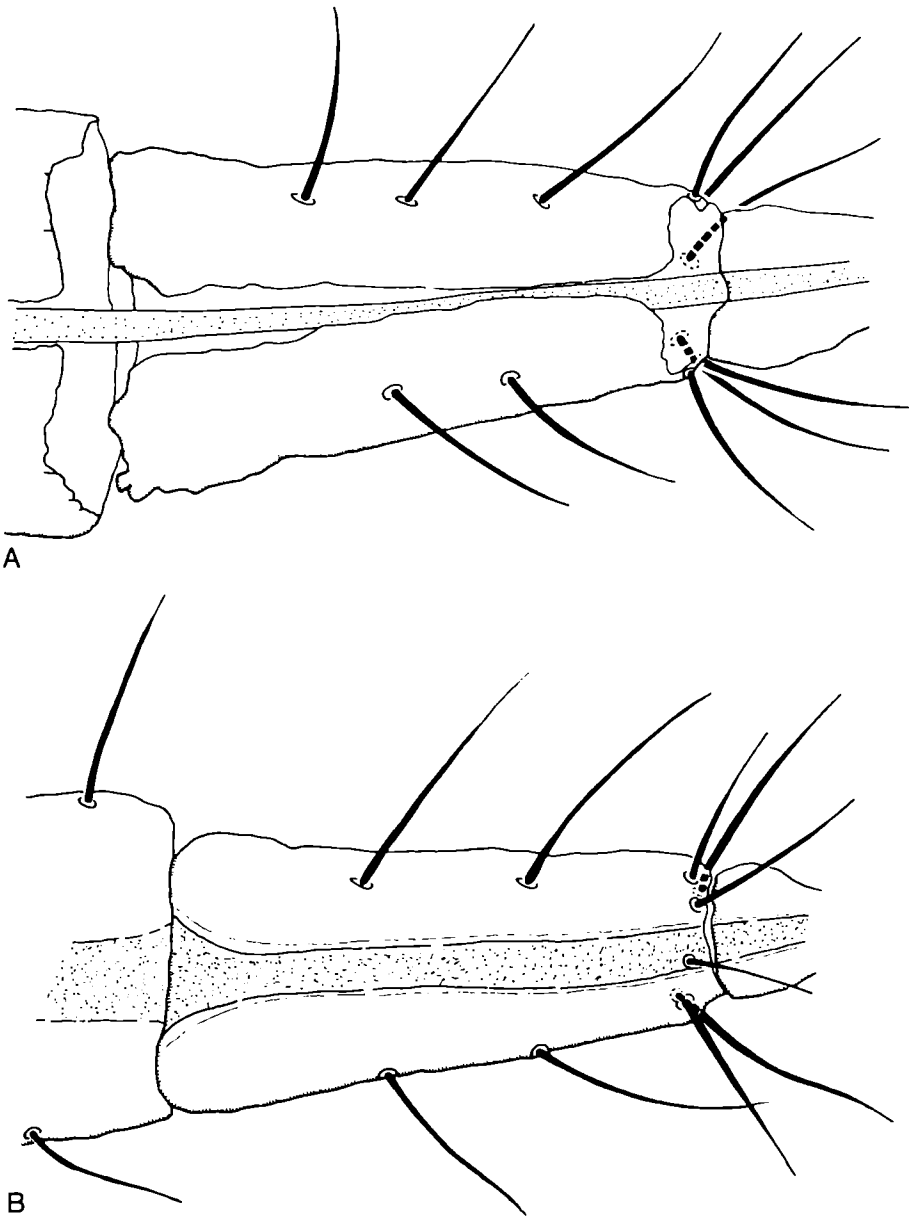

Figure 22. Rostral segments (R_4):
A. *Cinara laricis* alate male, B. *C. cuneomaculata* alate male.

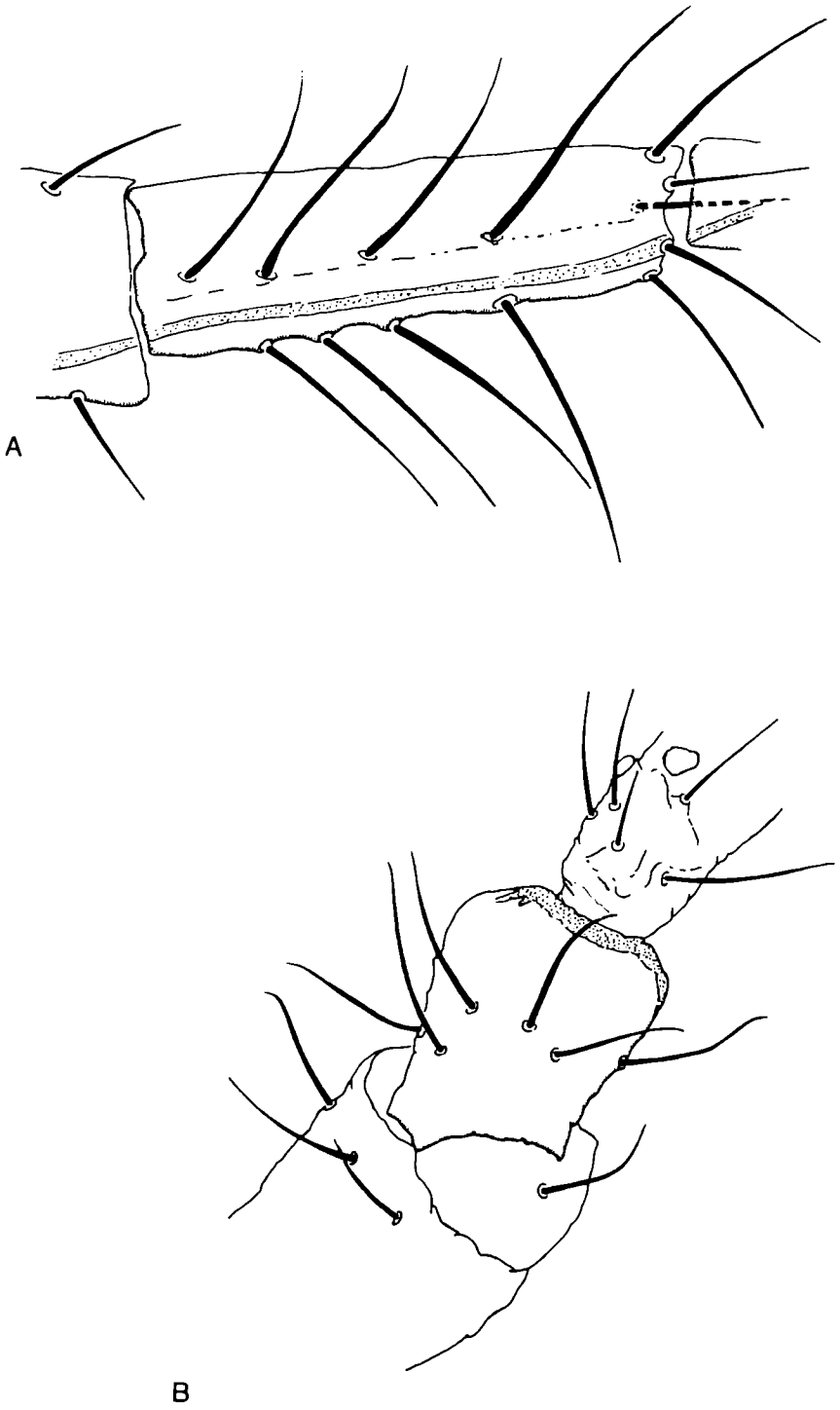

Figure 23.
A. Rostral segment (R_4) of *Cinara pectinatae* male, B. Antennal segment II of *C. pini* male.

7. ACCOUNTS OF THE SPECIES IN BRITAIN

Biological and morphological descriptions of conifer lachnids in Britain are given with details of their host plants life history, economic importance and distribution.

Eulachnus agilis (Kaltenbach, 1843)

Spotted pine aphid

(Text-figs. 8B, 9C, 12A, 13A)

Description

APTEROUS PARTHENOGENETIC VIVIPARAE: LENGTH: 2.2 to 2.7 mm. ABDOMEN: Elongated and bright green without a wax bloom. Numerous small dark reddish-brown scleroites of irregular shapes occur on the dorsum, bearing a single stiff, sometimes quite short, seta arising from each one. Siphunular cones small and insignificant. Segment VIII with long pointed dorsal spines. LEGS: Pale green, some slight dusky pigmentation occurring on femora and tibiae. Tibiae very long with long dark hairs. HEAD AND THORAX: Greenish. Head with setae in rows of 4 dorsally, eyes brown. ANTENNAE: Light greenish brown. Stiff black setae on each segment, their length barely exceeding the segment diameter on VI but usually distinctly longer on III. ROSTRUM: Tip of rostrum flattened apically, often almost rectangular in shape. Shoulder angle usually 15°–25° (range 5°–28°) (Fig. 13A) ALATE PARTHENOGENETIC VIVIPARAE: 2.2 to 2.5 mm long. WINGS: Forewing media branched once but connection between the branch and the costa is indistinct. WINGSPAN: 5.0–5.8 mm.

OVIPARAE: Apterous, 2.3 to 2.9 mm long. Similar to apterae except the adomen is slightly less narrow. Hind tibiae slightly thickened. Pseudosensoria mainly on proximal ¾ of tibiae (90 to 105 facets) often occurring as pairs, threes and sometimes fours.

MALES: Alate, 1.9 to 2.4 mm long. Wingspan 5.8 to 6.2 mm. Secondary sensoria on Ant. III, IV and V circular and numerous.

EGGS: Shiny black 0.64 mm long by 0.29 mm wide.

Host plants:

Found only on *Pinus* species. In Britain it has been recorded mostly from *P. sylvestris* and *P. nigra* var. *maritima,* usually feeding on the old needles. It is usually seen walking actively along needles and shoots and is very easily disturbed when foliage is examined. It is difficult to see when at rest because its shape and colours blend in with the foliage.

Life history:

Alatae and apterae have been found from June to October. The males have been seen in late October and oviparae in early November. Observations on this species made on introduced *P. sylvestris* in North America (Bliss & Kearby, 1971) show that the majority of eggs are deposited singly in leaf scars on the branches; a few are found on needles and other aerial parts of the tree. In the same study the fundatrices (hatching from the eggs) were shown to have a remarkable longevity averaging 103 days when reared at a constant 10°C. At this temperature it could be reproducing after 27 days and continue for a further 52 days. The fundatrices produced significantly more progeny than the virginoparae. In another study (Kearby & Bliss, 1969) the population trend was followed through a whole season. After a spring peak the numbers declined to an extremely low level from late June to early August, followed by high numbers from late August to late November.

Economic importance:

This species has been associated with loss of old needles on ornamental varieties of pine in nurseries. In some parts of North America it seriously affects the quality of *P. sylvestris* (grown for Christmas trees) by causing premature needle drop of the 2nd and 3rd year needles resulting in an extremely open tree. (Kearby & Bliss, 1969). The chemical control of this aphid has been investigated in North America (Adams, Cameron and Yendol, 1971).

Distribution:

Known principally in Southern England from Devonshire to Kent and from Cannock Chase, Staffordshire. A few summer migrants have been taken in suction traps along the eastern side of Britain from Elgin, Morayshire to East Anglia. This species has been recorded from Scandinavia through Europe to Turkey, China and parts of eastern N. America.

Eulachnus bluncki Börner, 1940

Narrow brown pine aphid or Jack-pine aphid

(Text-figs. 6B, 8A, 9E, 10A, 11A, 12B, 13B)

Recent synonymy:

E. rileyi (Williams, 1910).

Description:

APTEROUS PARTHENOGENETIC VIVIPARAE: LENGTH: 2.25–3.0 mm long, very elongate spindle-shaped body form. ABDOMEN: Rather variable in colour, usually dark orange brown, olive grey or brownish. Older specimens become covered with a wax bloom giving a grey or bluish appearance. Sometimes there is a tuft of wax filaments present posteriorly. Blackish setae occur on the dorsum. On cleared specimens, it can be seen that the setae usually arise from scleroites. Segment VIII with long pointed dorsal spines. Siphuncular cones represented by small blackish rings. LEGS: Generally darker than abdomen. Femora dark brown sometimes almost black. Hind tibiae very long and often blotched. Tibiae of forelegs usually distinctly paler. Legs have dark stiff setae particularly on the anterior edges. HEAD AND THORAX: Dark greyish brown, unevenly sclerotised. Eyes dark red. ANTENNAE: Pale brown with darker distal suffusion at the ends of segments III–VI. Longest setae on III usually 2¾ times the diameter of that segment. ROSTRUM: Tip of rostrum pentagonal. Shoulder angle usually 35°–45° (range 30°–50°). ALATE VIVIPAROUS FEMALE: Body length 2.5–3.0 mm, wing span 6.0–6.6 mm. Similar to apterae, but head and thorax darker with less prominent setae on the abdomen.

OVIPARAE: Apterous, 2.5–2.8 mm long, spindle shaped but somewhat broader than viviparae. Hind tibiae are slightly swollen, dark grey brown similar in colour to femora. Pseudosensoria on hind tibiae are small and pale (67–109 facets) usually polygonal in outline and are sometimes paired and occur mainly on proximal ¾ of segment.

MALES: Alate, body length 2.0–2.4 mm long, wing span 5.6–6.8 mm. Prominent sclerotised genitalia. Fewer weak setae on antennae; antennal segment III thicker than those of alate viviparae. Numerous small circular sensoria on segments III to V and a few secondary sensoria on segment VI.

Host plants:

Found feeding on the needles of various pines. British records are mainly from *Pinus nigra* var. *maritima* but also from *P. uncinata, P. sylvestris, P. contorta* and *P. radiata.* This aphid was originally described from specimens collected from *P. strobus* and *P. sylvestris* in Nebraska (Williams, 1910).

Life history:

Although apterous viviparae have been found in late May and from July through to October, alate viviparae appear to be the more common morph present throughout the summer and autumn months. Oviparae occur all through October and the males occur from late September to early November. Both these forms are quite common, the males, being active fliers, are regularly caught in suction traps sampling at 12.2m.

Economic importance:

Little is known about the effects of this species. Its apparent preference for *Pinus nigra* may be significant if it causes the same defoliation troubles that *E. agilis* can on *P. sylvestris.*

Distribution:

A fairly common species in the pine afforested areas of England and known from Morayshire, Tayside, Edinburgh and N. Wales. According to Pintera (1968) this species is very common in Central Europe, but apparently not present in the Mediterranean area. It also occurs across N. America on a wide variety of pines.

Eulachnus brevipilosus Börner, 1940

Narrow green pine aphid

(Text-figs. 8C, 9D, 10B, 11B, 12C)

Description:

APTEROUS AND ALATE PARTHENOGENETIC VIVIPARAE: LENGTH: 1.7 to 2.2 mm long. ABDOMEN: Vivid green without any noticeable wax bloom. Dorsal scleroite plates pale and indistinct when

living. Prepared specimens show these plates on the dorsum to be circular or oval, each bearing a seta that is shorter in length than the plate diameter. Segment VIII has a few longer capitate setae. LEGS: Yellowish or very pale brown sometimes with a dusky pigmentation pattern on tibiae and hind femora. Length of setae on the hind tibiae less than the tibiae width. (Some distal setae in the alate forms may be up to 1½ times the maximum diameter of the tibiae). Setae on other segments generally shorter. Most of the setae on hind tibiae have capitate ends. There are 6 to 8 setae on the ventral surface of tarsus I. Dusky and bearing setae anteriorly with capitate ends. THORAX: Darker in the case of alatae. WINGSPAN: 4.2 to 5.2 mm. ANTENNAE: Segments IV to VI usually darker than the first two segments. ROSTRUM: Obliquely ended as the other species.

Host plants:

Found almost always on *Pinus sylvestris* and only rarely on *Pinus nigra*. They feed on needles of trees of various ages. In other parts of Europe it is known chiefly from *Pinus mugo*.

Life history:

Apterae have been found from mid April until early November in Southern England. Alatae appear in mid June and are to be found on the host plant up to the end of August. Suction trap catches reveal the flight activity to start in early June and to go on sometimes quite late into September. In spite of the high numbers occurring in some years no alate forms or sexuales have been found in the autumnal period. The actual method of overwintering is not known.

Distribution:

This is probably the least common of all the British *Eulachnus* species, but is found in the pine growing areas of eastern Scotland and east and southern England. Other European records are from Germany to Scandinavia and Czechoslovakia.

Cedrobium lapportei Remaudière, 1954

(Text-figs. 6C, 8E, 9B, 24)

Description:

APTEROUS VIVIPARAE: LENGTH: 1.5–2.0 mm. COLOUR: Pale brown and grey with a paler longitudinal line running from the head to the anterior abdomenal segments. ABDOMEN: Rather flattened with the dorsal surface heavily sclerotised. The sclerotization occurs usually as large circular plates (up to four per segment) but in some specimens both transverse and longitudinal fusion takes place over segments III to VI so as to form one plate. Short colourless clavate setae occur over the body surface; barbules arise from the swollen distal ends. The siphuncular cones are small; the apex is slightly black. Between the cones the sclerotized areas are slightly raised as four mammillae and have less pigmentation. Further mammillae sometimes occur on other anterior segments. LEGS: Short and paler brown than the body. The distal fifth of the hind tibiae and the tarsi are darker. Hind tarsus I very short, the dorsal length being shorter than the base. ANTENNAE: Consisting of only five segments. The last segment, V, has two subapical setae; there is no chitin rim to the primary rhinarium. The segments are paler than the body colour but the fifth segment is somewhat darker. ROSTRAL LENGTH: 0.75–0.8 mm with two secondary setae on R_4.

ALATE VIVIPARAE: LENGTH: 1.7–1.8 mm. Similar in colour to viviparae but with legs and antennae darker. ABDOMEN: With small intersegmental scleroites transversely arranged. The clavate setae do not apparently occur in this morph. WINGS: Long with a brown anterior margin. ANTENNAE: Antennal III much larger than in the apterae and having up to five protruding senoria. ROSTRAL LENGTH: 0.7 mm–0.75 mm, with two secondary setae on R_4

Host plants:

Cedrus atlantica, C. deodara and *C. libani*. FEEDING SITE: Found as small dense colonies on the twigs and dwarf shoots on the lower branches.

Life history:

Incompletely known in Britain, but probably exists anholocyclicly. Apterous and alate viviparous females have occurred in May and June. Single apterae have also been found from August to the end of October. In the cold winter districts of Morocco where this insect was first recorded (Remaudière, 1954) the winter was spent in the egg stage; males and the first oviparae appeared in mid October.

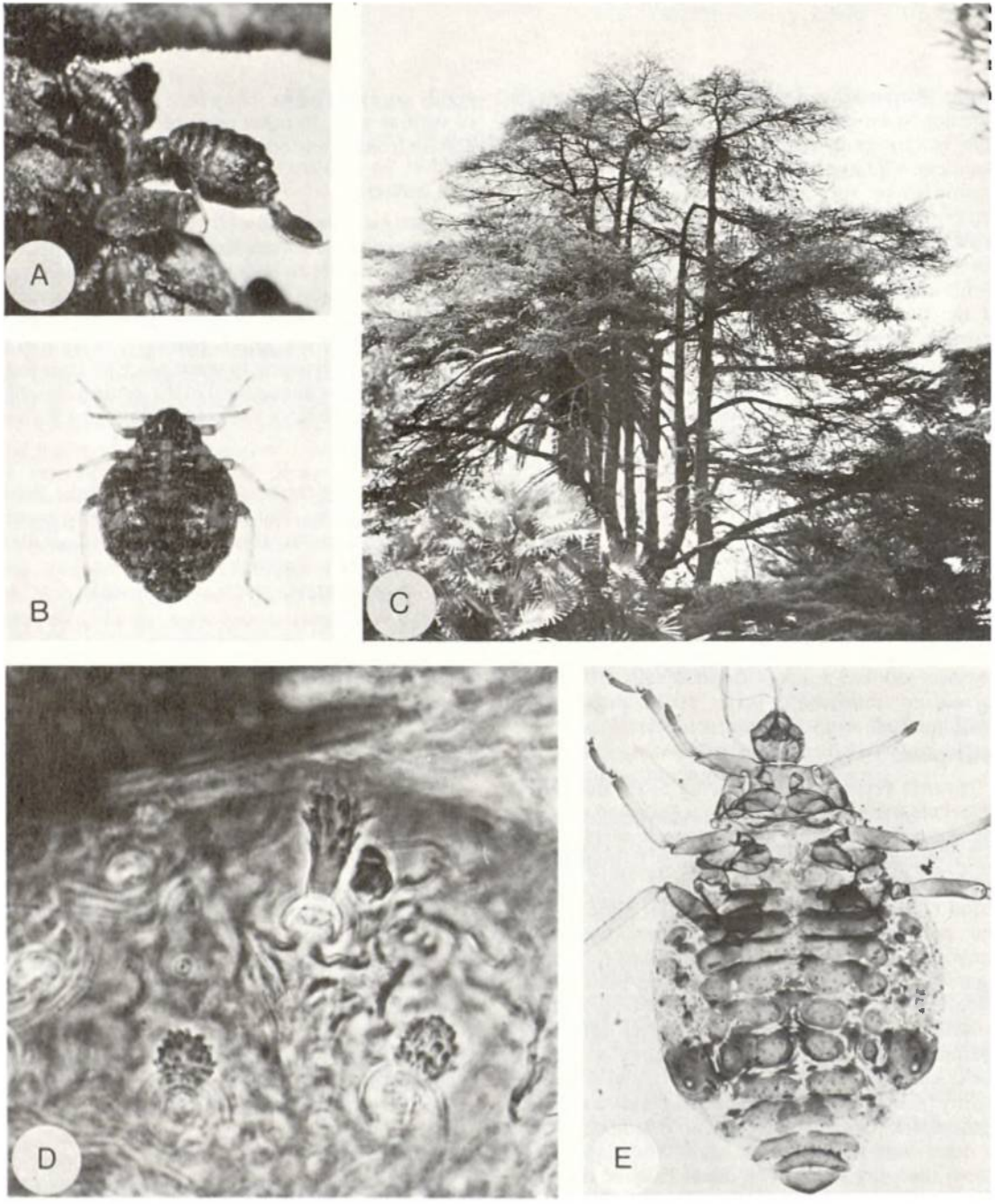

Figure 24. *Cedrobium lapportei:*

A. Small colony of aphids amongst the old needle bases on *Cedrus*.

B. Adult aptera.

C. Severe defoliation to the crown of *Cedrus libani* caused by aphid feeding.

D. Phase contrast detail of clavate setae on the dorsum of the abdomen.

E. Cleared specimen showing the sclerotised plates ("mammillae") between the siphuncular cones.

Economic importance:

The feeding activity of small colonies in the spring causes a rapid loss of old needles. Tree appearance changes markedly and in *C. libani* the shade effect is lost. There is some evidence that badly affected twigs and possibly whole branches do not recover from a heavy defoliation. Another feature of this aphid is honeydew production and, since the aphid colonises the foliage of spreading branches, the honeydew can fall over a wide area. Sooty moulds readily grow on the honeydew both on the twigs of lower branches and the ground.

Distribution:

Has rapidly spread northwards through Europe since 1967. It was first suspected here at Kew Gardens in 1974 and has since been found there again. In 1976 the insects and reports of damage have been obtained from Surrey, Kent, S. Devon and Lincolnshire. Alatae have been found in suction trap catches from Devon, Hampshire, Sussex, Kent, Surrey, London, Essex, Lincoln and Dundee.

Schizolachnus pineti (Fabricus, 1781)

(Text-figs. 6A, 8F, 9A)

Recent synonymy:

Previously also known as *S. tomentosus* (Villers).

Description:

APTEROUS PARTHENOGENETIC VIVIPARAE: LENGTH: 2.5–3.0 mm (fundatrices) subsequent generations smaller 1.2–2.5 mm. ABDOMEN: Broad and oval in outline. Dark greyish green covered in wax meal deposit and long fine hairs giving an overall light grey colour. Cleared specimens show the sclerotisation to be mainly restricted to small muscle attachment plates. A transverse row of about 12 fine setae are present on the dorsal surface of each segment. The siphuncular cones are small and have a band of pigmentation around the rim about equal to the diameter of the siphuncular opening. LEGS: Rather pale but femora and tibiae becoming darker both distally and at the articulating surfaces. Tibiae with long fine hairs the lengths being about 2–3 times the diameter of that segment. HEAD AND THORACIC PLATES: Weakly pigmented; the eyes are black. ANTENNAE: Segment IV distinctly shorter than V. ROSTRAL LENGTH: 0.62-0.67 mm, last joint very short and obtuse shaped.

ALATE PARTHENOGENETIC VIVIPARAE: LENGTH: 2.0-3.0 mm. Appears rather heavy bodied in proportion to wing-span. WINGS: The forewing has a very faint media vein that branches once. Wing span 5.5–8.0 mm.

OVIPARAE: Apterous, body length 1.7 mm. There is a prominent genital plate and rudimentary gonapophysis. The swollen hind tibiae of this morph show granular pseudosensoria.

MALES: Alate, body length 2.45 mm. Genitalia prominent. The legs are generally darker and there is a very long second hind tarsus segment. TI/TII, 1:3.5. Antennal segment III and IV with many circular rhinaria (III 35–40, IV 8–10) give these segments a corrugate profile.

EGGS: Black, 0.75 mm long.

Host Plants:

Pinus contorta, P. nigra, P. sylvestris, are the most frequently recorded host plants in Britain. It is usually found on young trees where it forms densely packed colonies in rows along the needles (see Cover plate). The aphids colonise the new seasons needles by late June or early July. Substantial colonies have occurred on *P. sylvestris* seedlings by mid September. This species has also been found on certain other less common pines *P. mugo, P. pinaster* and *P. tabulaeformis yunnanensis.*

Life history:

Fundatrices have been found in May, and from then on small colonies of parthenogenetic generations occur until the autumn. Alate females appear from May until September. Alate males have been found in mid October and oviparae from early November to early December. The eggs have been seen unhatched in late February. In some years the colonies appear to persist into the early winter and it is possible that this insect may also persist through favourable winters by parthenogenetic forms alone. Heavily parasitised colonies where individual apterae became mummified have been found in July.

Economic importance:

This aphid is usually associated with young pines and its feeding activities appear to be associated

with needle yellowing which precedes premature needle shedding of the older needles. In a similar way to how the Green spruce aphid brings about growth loss by its feeding activity (Carter, 1977), this aphid will also reduce photosynthetic area and storage tissue thus causing a reduction of shoot and needle elongation in next seasons growth (Thompson, 1977). Such infested plants would be inferior quality transplants.

Distribution:

A widespread and common species in Great Britain, Ireland and in Europe from Scandinavia to Turkey. There is a possibility of another species *S. obscurus* Börner being present here as it occurs on *Pinus nigra* in Central Europe and *Pinus* in the Middle East (Bodenheimer and Swirski, 1957). *S. piniradiatae* (Davidson, 1909) is a widespread pest of pines in N. America (Kulman, 1967).

Cinara acutirostris Hille Ris Lambers, 1956

(Text-fig. 25B)

Description:

APTEROUS PARTHENOGENETIC VIVIPARE: LENGTH: 2.6–4.1 mm. ABDOMEN: Dark brown or bronze coloured with wax flecks; scleroites not fused together; dorsal bristles between siphuncular cones; cauda slightly pointed. THORAX: With prominent mesosternal tubercle. LEGS: Pale, dark at the joints, distal portion of the tibiae dark. ANTENNAE: Primary rhinarium on antennal VI with a chitin rim. Four sub-apical setae on the processus terminalis. ROSTRAL LENGTH: 2 mm.

ALATE VIVIPARAE: LENGTH: 3–4.1 mm. Similar to apterae. LEGS: Predominantly dark with pale areas proximally.

OVIPARAE: Dark brown body colour with white wax marks laterally on the dorsum. LEGS: Hind tibiae without pseudosensoria.

MALES: Apterous and slender body form. Body length 2.7 mm.

Host plants:

Pinus nigra var. *nigra* and var. *maritima*. FEEDING SITE: Bark and older twigs.

Life history:

Eggs have been found hatching in the second half of March at Cambridge (Eastop, 1972). Alate viviparae occur from the second half of June and have occurred up to early August in suction traps. An abundance of oviparae with a very small number of apterous males occurred at Cambridge in early October (Stroyan, 1955).

Distribution:

Rare in Britain, has only been recorded on specimen trees in Cambridge in 1950/51. Winged viviparae have been taken in suction traps at Alice Holt, Hants; Long Ashton, Somerset; Silwood Park, Berks; Starcross, Devon; and Wye, Kent. It is only recorded from a few European countries south of the latitude of England, where its host plant *P. nigra* occurs.

Cinara brauni Börner, 1940

(Text-fig. 18B)

Description:

APTEROUS VIVIPARAE: LENGTH: 2.5–3.8 mm. ABDOMEN: Golden brown with waxy powder on both dorsal and central surfaces. The sclerotisation of the siphuncular cones extends transversely over the posterior of the abdomen. LEGS: Length of hind tarsus II exceeding 1.9 times ventral length of hind tarsus I. ANTENNAE: Primary rhinarium on antennal VI with a chitin rim. Five to eight blunt subapical

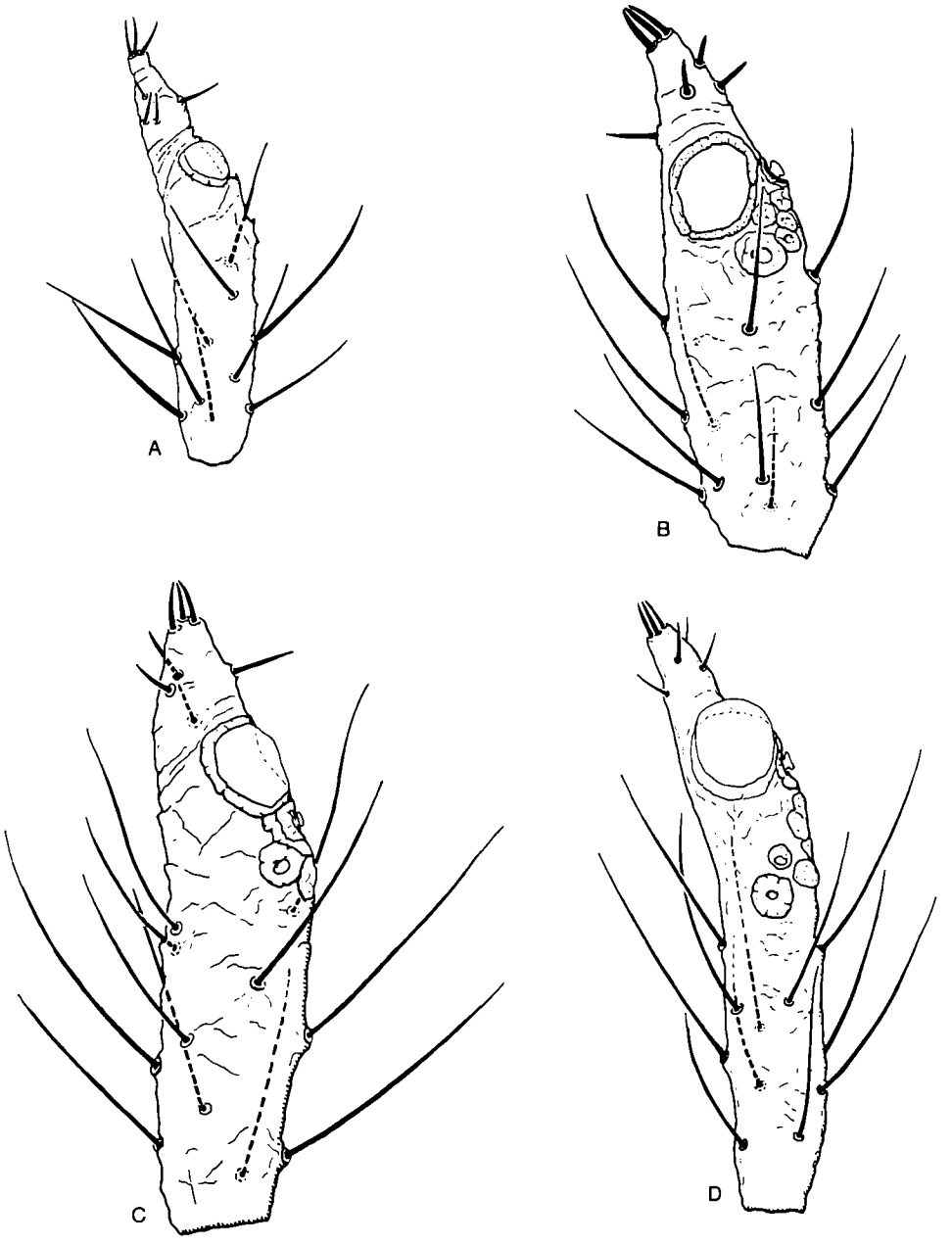

Figure 25. Antennal segments VI:
A. *Cinara cedri* alate ♀, B. *C. acutirostris* alate ♀, C. *C. pruinosa* alate ♀, D. *C. confinis* alate ♀.

setae on processus terminalis. ROSTRAL LENGTH: 1.8 mm long, and having six secondary setae on R_4.

ALATE VIVIPARAE: LENGTH: 2.8–3.8 mm. ABDOMEN: Differs in that the posterior sclerotisation is reduced so the siphuncular cones are separated and large. Sclerotised patches or transverse bars are present posteriorly.

OVIPARAE: Similar to the apterous viviparae in having extensive posteriodorsal sclerotisation on the abdomen. The mature adults have a bright white pericaudal wax ring. There is a waxy powdering on the sides and ventral surface.

MALES: Alate. ROSTRUM: Eight secondary setae on R_4. A fuller description of the sexual forms and the fundatrices is given by Scheurer (1971).

Host plants:

Pinus nigra. FEEDING SITE: Has been found on current and previous year's shoots of 8–10 year old trees.

Distribution:

Has only been recorded once from suction trap at Alice Holt, Hampshire. Elsewhere it is rare and known only from a few central European countries. Insects have been studied in some detail by Scheurer from the Harz Mountains in Germany. It is attended by the ant *Formica rufa*.

Cinara cedri Mimeur, 1935

(Text-fig. 25A)

Description:

The following description is based mainly on an account by Mimeur (1935), a more recent account of this species in Italy has been made by Covassi and Binazzi (1974).

APTEROUS PARTHENOGENETIC VIVIPARAE: LENGTH 2.5–3.0 mm. ABDOMEN: Brilliant reddish brown, with two dark longitudinal bands separated by a lightly coloured line. The siphuncular cones are black. The aphids are covered in wax giving them a whitish appearance. LEGS: Light brown; the femora are black in the middle and yellow at the apices; the tarsi are black; setae on the femora are about 0.10 mm long. ANTENNAE: Segments I and II are light yellow, III to V yellow although these segments are black at the apices. Primary rhinarium (ant VI) has a chitin rim, although this is not always distinct; there are usually four sub-apical setae. ROSTRAL LENGTH: 1.4–1.8 mm; R_5 with 6 to 8 pairs of setae alongside the rostral groove.

ALATE PARTHENOGENETIC VIVIPARAE: LENGTH: 3.0 mm. WINGSPAN: 6.15 mm. ABDOMEN: As for apterae except that it does not have dark longitudinal bands, however it has many scleroites which distinctly show the segments; there are two black areas between the siphuncular cones. WINGS: Yellow, variation brown. LEGS: The anterior and medial femora are yellow but with black apices, the posterior femora are black on the basal two thirds; the anterior tibiae are black, the tarsi are dark brown. ANTENNAE: Covered with many round secondary sensoria, their diameter is similar to the segment on which they occur. ROSTRUM: Yellow except for segment five which is brown.

SEXULES: So far neither oviparae nor males have been recorded in Britain. The oviparae are similar to the apterous viviparae but can be distinguished by the tibiae of the hind legs which are swollen and bear numerous pseudosensoria. The males are alate and generally smaller than the alate viviparae with darker legs. Further microscopic details of these morphs are given by Stroyan (1979).

Host plants:

Cedrus atlantica and *Cedrus libani*. FEEDING SITES: They form small colonies on the branches.

Life history:

Apterous parthenogenetic viviparae have been found in Britain during July. During October sexuparae and their offspring have been found (but not in Britain) in small groups hiding under the lichen *Parmelia furfuracae* Ach. var *olivetorina* (Zopf) which covers some of the branches.

Distribution:

Very rare in Britain, has only been found at Kew (private communication V.F. Eastop), There is an old report of damage to *Cedrus deodara* in January and February from Devonshire (Anon, 1898) that may be this species.

Cinara confinis (Koch, 1856)

(Text-fig. 25D)

Recent Synonymy:

Placed under the generic name of *Todolachnus* or *Dinolachnus* in some publications and under the trivial names *cilicica* (del Guercio) or *cecconii* (del Guercio). The name *Lachnus abieticola* Cholodkovsky has recently been regarded as a synonym (Eastop and Hille Ris Lambers, 1976).

Description:

APTEROUS AND ALATE PARTHENOGENETIC VIVIPARAE: LENGTH: 3.8–7.8 mm. ABDOMEN: Dark brown or greenish black with a double row of blackish slightly shining speckles and small flecks of fine wax in transverse rows. Siphuncular cones dark and prominent. LEGS: Tarsi black; tibiae and femora somewhat variable in colour, either with dark brown annulations or mainly black except for a proximal portion; articulating areas between the two segments blackish. HEAD AND THORACIC PLATES: Dark brown. ANTENNAE: Pale yellowish grey with a darkening of each segment distally. Primary rhinarium on antennal VI without a chitin rim. Three or more, usually four, sub-apical setae are borne on the processus terminalis. ROSTRAL LENGTH: 2.6–2.9 mm.

OVIPARAE: Similar to the viviparae. There is no posterior wax-ring deposit on the abdomen of this species. There are numerous conspicuous pseudosensoria on the hind tibiae.

MALES: Alate, not recorded in Britain.

EGGS: Laid on the needles.

Host plants:

Abies alba, A. cicicica, A. grandis, A. meriesii, A. procera, Cedrus deodara, C. libani. FEEDING SITE: Usually found on the stems and twigs of trees; it has been found less frequently on the roots of *Abies*.

Life history:

Incompletely known in Britain. Of the parthenogenetic forms the apterae occur between March and October making large colonies in the summer months; the alatae occur in June and July. A few apterae have been found on roots in September in Scotland. Wood-Baker (1964) records this species as sometimes occurring in special earth galleries constructed by ants on the bark of *Abies*.

Economic importance:

From time to time this species has been found to occur in abundance on large trees, particularly *Cedrus* when growing in urban areas. The lack of woodland predators appears to enable colonies to reach enormous size and these aphids are often to be found wandering over much of the tree. This wandering activity often leads to the aphids leaving the tree. In addition, its large appearance and the fact that it is easily squashed makes this species something of a public nuisance when crawling into nearby buildings. Additional problems are honeydew deposits, sooty moulds, and sometimes wasps that feed on the fermenting honeydew sugars and become rather drowsy.

Distribution:

Of sporadic occurrence in Britain. It has been found on *Abies* in forest plantations at widely separated locations, namely northern Scotland, west of Ireland as well as arboreta and forests in southern England. Stenseth and Bakke (1968) have recorded this species from northern Norway and suggest that the species can tolerate localities with great variations in climate. Eastop (1972) discusses the possibility that some other described species may be forms of *confinis* in which case its distribution could be regarded as probably holarctic.

Cinara costata (Zetterstedt, 1828)

(Text-figs. 15B, 26A, 27C)

Description:

APTEROUS VIVIPARAE: LENGTH: 2.7–3.8 mm. ABDOMEN: Light brown or yellow-brown background colour sometimes with a dull metallic gold sheen. There is a dark bottle-green longitudinal stripe either side of the mid line on the dorsum, sometimes coalescing posteriorally in the area of the siphuncular cones. The aphids have a superficial grey colour due to the mealy wax deposit. The siphuncular cones are dark brown and prominent usually spaced three or more diameters apart. LEGS: Tibiae dark

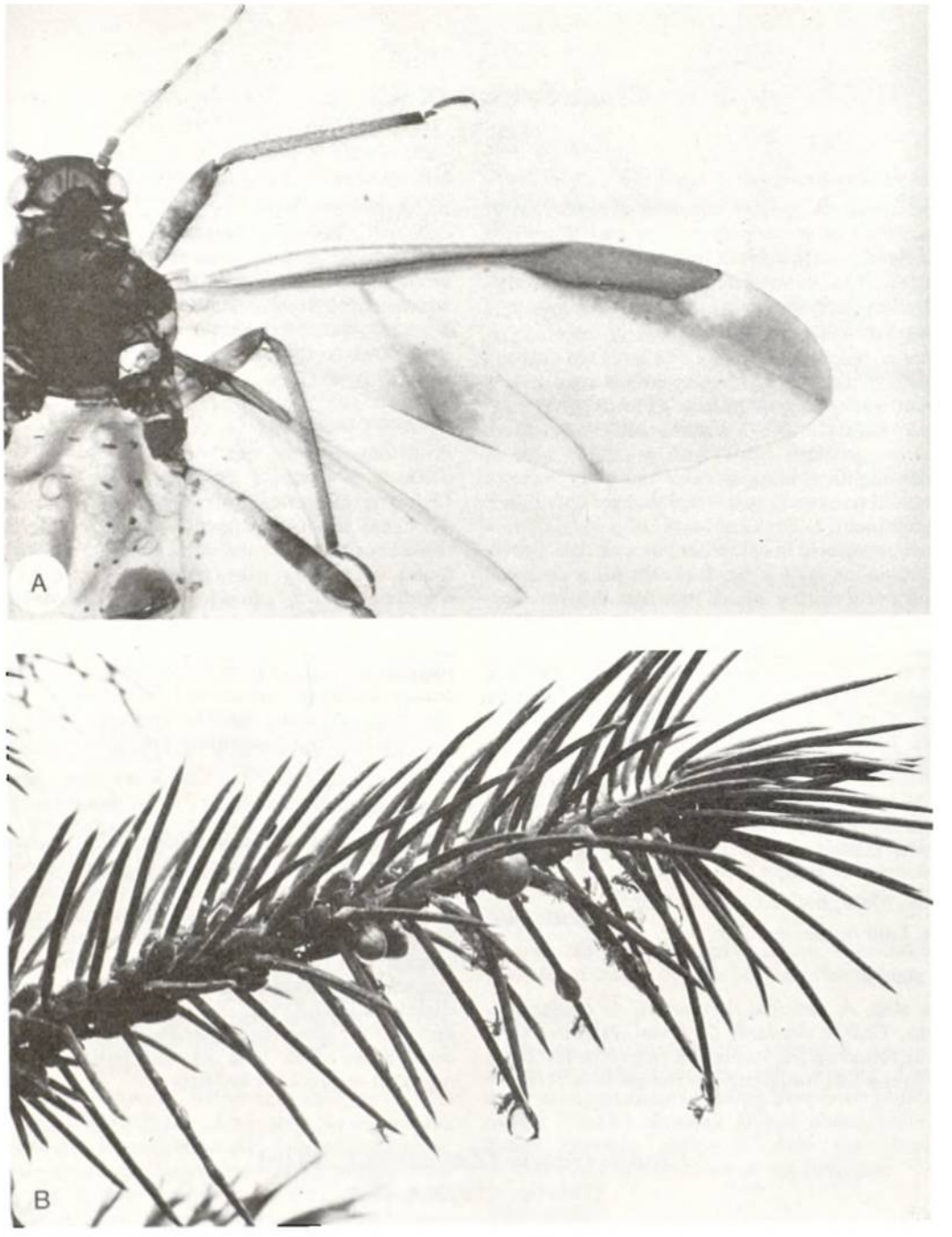

Figure 26.
A. Wing venation of *Cinara costata*, B. Colony of *C. pilicornis* first generation on shoot axis of *Picea sitchensis* in the early spring before the buds have burst. Honeydew excreted from the colony has accumulated.

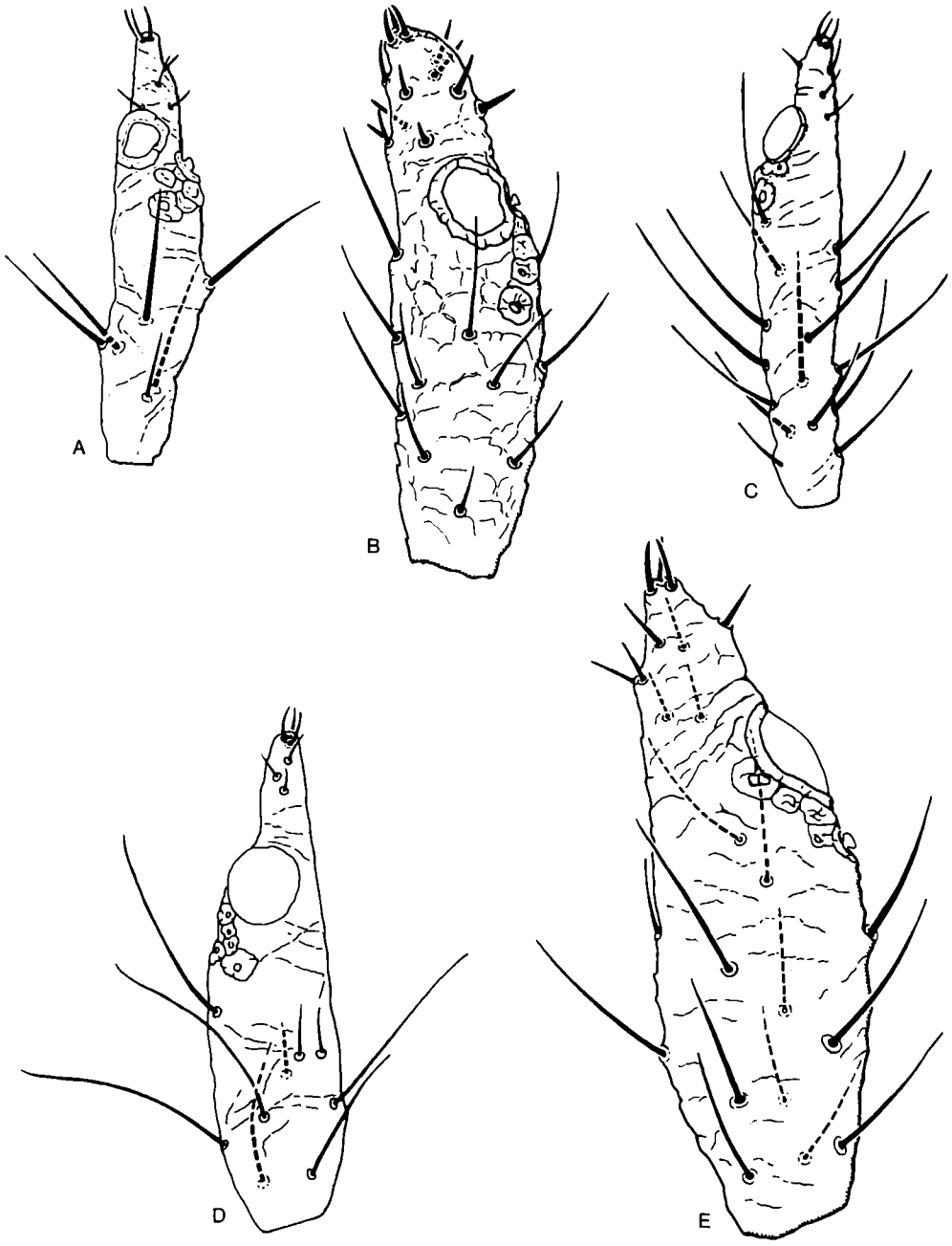

Figure 27. Antennal segments VI:
A. *Cinara pectinatae,* B. *C. piceae,* C. *C. costata,* D. *C. fresai,* E. *C. escherichi.*

brown distally shading to a straw yellow. The longest tibiae hairs are 0.2 to 0.25 mm in length and often collect the secreted wax particles. ANTENNAE: Primary rhinarium on antennal VI with a chitin rim; sub-apical setae usually four, but sometimes three in number. Segment VI about equal in length to V. ROSTRUM: 1.2–1.4 mm long with four or six secondary setae on R_4.

ALATE VIVIPARAE: LENGTH: 3.0–4.4 mm. Similar to apterae. It is the only *Cinara* in Britain with pictured wings. There is a single fork to the median vein of the forewing.

OVIPARAE: Tibiae swollen with conspicuous pseudosensoria. Pigmentation of sclerotised areas weaker than viviparae.

MALES: Alate. LENGTH: ca 2.5 mm. Pictured wings similar to alate viviparae.

Host plants:

Principally *Picea abies*, but also found on *P. koyamai*, *P. orientalis* and *P. sitchensis*. It appears to favour the smaller lignified twigs.

Life History:

Apterous and alate viviparae are most frequently seen in May, June and July. Small colonies are found on twigs of the lower branches of *Picea*. The appearance of the colony is somewhat obscured by a deposit of mealy wax on the twigs. Alatae and apterae have been recorded later on in October. An alate male and some oviparae have occured in November.

Distribution:

Not very common and never abundant. Has occurred mainly in southern England from Northamptonshire in the north and to Gloucestershire in the west; some specimens have been collected in the past in Lake District. It has been recorded over a wide area of the Northern Temperate zone and Australia (Eastop, 1972).

Cinara cuneomaculata (del Guercio, 1909)

(Text-figs. 7A, 14A, 14C, 22B)

Synonymy:

C. laricicola Börner and *C. boerneri* Hille Ris Lambers are names that have been given to this species. However, it appears that the species has been confused with the other two aphids that dwell on larch namely *C. laricis* (Hartig) and *C. kochiana* (Börner), see Eastop (1972).

Description:

APTEROUS AND ALATE PARTHENOGENETIC VIVIPARAE: LENGTH: 2.4–4.6 mm. ABDOMEN: Colour somewhat variable from a darkish brown to orange-reddish sometimes with blackish green segmental markings. There is usually a greyish wax powder on the ventral surface of adults which tends to extend as segmental stripes on to dorsum of the abdomen. The siphuncular cones are small. LEGS: Hind tibiae dark for up to two thirds their length; femora dark brown paler proximally. ANTENNAE: One to seven secondary rhinaria on antennal III of apterae; seven to thirteen (usually nine or ten) in the case of alatae. Primary rhinarium on antennal VI without a chitin rim. Four sub-apical setae often short and blunt on processus terminalis. ROSTRAL LENGTH: 1.5 mm.

OVIPARAE: Dark brown with larger darker sclerotised blotches, no pericaudal wax ring. LEGS: Mainly dark brown with paler areas. Hind tibiae usually thickened with numerous pseudosensoria.

MALES: Alate. BODY LENGTH: 2.7 mm.

EGGS: About 1 mm. long, black and shiny.

Host plants:

Mainly *Larix decidua* less frequent on *L. kaempferi*. FEEDING SITE: Young twigs and shoots.

Life history:

The eggs are laid often in clutches on the dwarf shoots and bark of larch. Apterae have been found from mid May to September. Alatae have occurred between a brief period from June to 12 July both on *Larix* and in suction traps. Alate males have been found in October and November both on *Larix* and in suction traps; the oviparae have been found in October.

Economic importance:

This species occurs in small colonies on young shoots and has been fairly plentiful on occasions on nursery stock plants. It is reputed to produce much honeydew, and although not necessarily attended by

ants it is regarded as a valuable source of forage for honey-bees in larch growing areas. There is some evidence that dense overpopulated colonies caused a local yellowing of the foliage (Börner and Franz, 1956).

Distribution:

Known mainly from the eastern counties of England, Kent, Hampshire, Surrey, Berkshire, Oxford, Hertfordshire, Cambridgeshire, Gwent, Yorkshire, Northumberland and similarly in Scotland, Midlothian, Fife and Angus. It is in these areas where much larch is planted. It is known from several European countries excluding Scandinavia and the Iberian peninsula.

Cinara cupressi (Buckton, 1881)

(Text-figs. 4A, 16B, 17A, 17B)

Cypress aphid

Description:

APTEROUS AND ALATE PARTHENOGENETIC VIVIPARAE: LENGTH: 1.8–3.9 mm. ABDOMEN: Orange brown to yellowish brown, the dorsum being covered with a pale grey tomentum making a pattern of transverse stripes. There is a double row of blackish spots that diverge from the thorax posteriorly, and an ill defined transverse blackish band linking prominent black siphuncular cones. Prepared specimens do not show this patterning, the scleroites are very small or absent and the whole aphid is clothed with fine hairs. LEGS: Yellowish, distal ends of tibiae and femora dark brown to black. HEAD: with dark eyes. ANTENNAE: Primary rhinarium on antennal VI without a chitinised rim; 3 or less often 2 sub-apical setae on processus terminalis. ROSTRAL LENGTH: 0.9–1.0 mm.

OVIPARAE: Apterous. ABDOMEN: Similar to above, and does not have a pericaudal wax ring to aid recognition of this form in the field. LEGS: Hind tibiae with numerous conspicuous pseudosensoria.

MALES: Alate, but not recorded in Britain so far.

EGGS: Yellowish brown when first laid, 1.2–1.3 mm long by 0.6 mm wide.

Host plants:

Usually recorded from *Cupressus macrocarpa*, but has also been found on *C. funebris, Juniperus chinensis, Thuja orientalis*. FEEDING SITE: This species is found amongst the foliated parts of the crown, and as it has a relatively short rostrum it is most likely to feed on foliage or thin barked twigs.

Life history:

The egg stage is recorded in this bulletin for the first time in Britain. Colonies of viviparae occur from May to November; alate forms appearing in June to August. Oviparae and males have been recorded in October. It seems possible that viviparae may sometimes overwinter under mild conditions.

Economic importance:

This species produces large quantities of honeydew. When this falls on dense foliage it makes an ideal substrate for sooty mould growth. The presence of this aphid is thought to reduce vigour considerably by removal of sap and by the sooty mould deposits, which may kill the foliage. Certain peak years 1923, 1935, 1937 and 1939 of high infestations were recorded at Wisley (Fox Wilson, 1948).

Distribution:

Although this insect is widely distributed and quite frequently found in the warmer parts of Europe where *Cupressus* grows it is only rarely found on plant material in Britain in spite of the extensive planting of the many species and varieties in parks and gardens. In Britain it is only recorded from the southern and south-western counties of England, the regions of mild climate where its chief host *Cupressus macrocarpa* has been planted and survives. The more frequent occurrence of the alate forms in suction traps sampling at 12.2 m high than the sporadic records of specimens collected from host plants suggests that this species may immigrate into Britain.

Cinara escherichi (Börner, 1950)

(Text-fig. 27E)

Description:

APTEROUS AND ALATE VIVIPARAE: LENGTH: 3.5–4.25 mm. ABDOMEN: Brownish and shining, slightly powdered with wax. There is no marked patterning to the dorsum but it carries numerous short hairs. Siphuncular cones evident. ANTENNAE: Primary rhinarium on antennal VI with a chitinised rim. Six or seven (rarely 5 or 8) subapical spines on processus terminalis. ROSTRAL LENGTH: 2.1 mm.

Host plants:

Pinus sylvestris: FEEDING SITE: Predominantly on the main stem and on basal parts of older branches or under patches of bark, according to Pintera (1966); it is also reputed to occur on the two to eight year old portion of leading shoots (Heinze, 1962).

Life history:

Rather incompletely known, apterous males and oviparous females are mentioned by Pašek (1954). Presumably eggs have been seen in Central Europe; Pašek describes and illustrates the fundatrix. In the spring large colonies occur on the trunk and old branches, whereas in the summer smaller groups occur under bark. The colonies are ant attended.

Economic importance:

No direct injury has been observed. The honey-dew is most attractive to bees.

Distribution:

Known in Britain from a single alata taken in a suction trap at Alice Holt, Hants, (Maslen & Carter, 1973) and from *P. sylvestris* Thursley Common, Surrey 4. vii. 1972 (Joyce Pope coll.). Chiefly found in Central Europe—namely Austria, Czechoslovakia, Germany and Poland.

Cinara fresai (Blanchard, 1939)

(Text-figs. 19B, 20B, 20C, 27D, 28B)

Recent synonymy:

This species has also been known as *C. juniperina* (Mordvilko), but that name is probably more correctly regarded as a synonym of *C. cupressi* (Buckton), see Eastop, 1972.

Description:

APTEROUS PARTHENOGENETIC VIVIPARAE: LENGTH: 2.2–4.2 mm rather elongate. ABDOMEN: Pinkish grey to dark brownish grey with superficial white meal speckling. A double row of black segmental blotches diverge on the anterior half of the abdomen making an inverted V pattern. The siphuncular cones are prominent, black and shining. LEGS: Dark brown to black especially at articulating surfaces. The whole body and appendages are coated with long pale hairs. ANTENNAE: The primary rhinarium on antennal VI is without a chitin rim; there are three subapical setae borne on the processus terminalis. ROSTRAL LENGTH: 1.4 mm.

ALATE PARTHENOGENETIC VIVIPARAE: LENGTH: 2.7–4.2 mm. ABDOMEN: As above but with a reduced abdominal pattern. ANTENNAE: Segment III with 6–11 secondary rhinaria. No males or oviparae of this species are known in Britain. Specimens of oviparae collected elsewhere in Europe (Klimaszewski *et al* 1977) and assigned to another species *C. mordvilkoi* (Pašek) may be *C. fresai*, but this has yet to be demonstrated.

Host plants:

Juniperus chinensis, J. sabina, J. squamata, J. virginiana, and their cultivated varieties. It does not appear to occur on the native *J. communis.* FEEDING SITE: Foliage and adjacent woody shoots.

Life history:

Apterous viviparae occur from May to October and sometimes later in unheated glasshouses; colonies occur from June onwards. Alate viviparae have been found on infested plants from June to August.

Economic importance:

This aphid is capable of making large dense colonies on the young stems of ornamental junipers. Such colonies yield large quantities of honeydew, resulting in abundant sooty mould growths. The aphids appear most damaging in this respect to the quality of container grown plants when they are ready for planting.

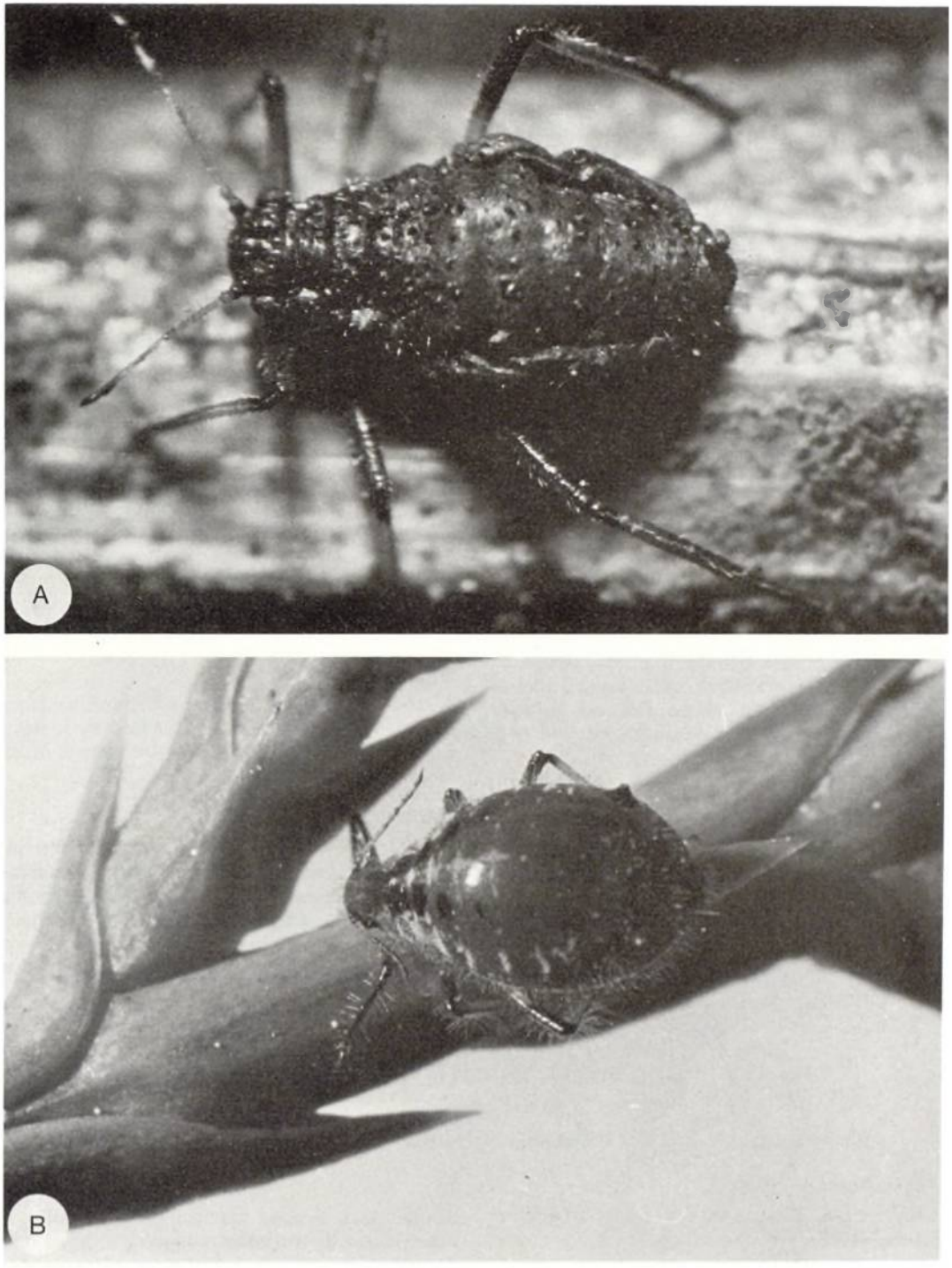

Figure 28.
A. *Cinara laricis* adult apterous viviparous female, B. *C. fresai* adult apterous viviparous female.

Distribution:

Known only from a few locations in Southern England, Hampshire, Kent and Surrey. The species is only doubtfully recorded elsewhere from Europe. In Australasia and North America it has additionally been found on certain species of *Cupressus* and *Cryptomeria*.

Cinara juniperi (de Geer, 1773)

(Text-figs. 18C, 19C, 20A)

Description:

APTEROUS PARTHENOGENETIC VIVIPARAE: LENGTH: 2.4–3.4 mm, rather more rounded in profile than *C. fresai*. ABDOMEN: Pinkish brown without any striking pattern. The siphuncular cones are relatively large but are not always particularly dark and prominent. LEGS: Dark brown to black, hind tibiae all dark. ANTENNAE: The primary rhinarium on antennal VI is without a chitin rim; there are three sub-apical setae borne on the processus terminalis. There is often a constriction in the basal portion of this segment. ROSTRAL LENGTH: 0.7–0.9 mm.

ALATE PARTHENOGENETIC VIVIPARAE: LENGTH: 2.6–3.1 mm. ABDOMEN: Similar to above, siphuncular cones smaller than apterae. LEGS: Dark brown to black. ANTENNAE: No chitin rim on primary rhinarium of segment VI. Segment III with 4–8 secondary rhinaria.

Host plants:

The majority of records are from the native *Juniperus communis* and its varieties. It has also been found on *J. conferta, J. chinensis, J, oxycanus, J. oxycedrus, J. rigida* and *J. squamata*. There is a single record of a colony being found on *Chamaecyparis lawsoniana*. FEEDING SITE: This species favours the underside of young shoots and feeds on the foliage.

Life history:

Apterous viviparae have been found throughout the year as single individuals. Small colonies occur in the early summer on the tender new green shoots and foliage. Alate viviparae have been found mostly in May and June, but odd individuals sometimes appear in July and August. Neither oviparae, eggs nor males have been recorded from the many recent observations made by us, or in the invertebrate fauna survey of juniper made by Ward (1977). It is possibly holocyclic in Northern Britain and Central Europe; the males according to Buckton (1881) are thought to be apterous.

Economic importance:

A moderate amount of damage to nursery stock and ornamental plantings can be caused by honeydew deposits on the foliage and by the growth of sooty moulds.

Distribution:

Widely distributed in Britain. Records tend to follow the natural distribution of *J. communis*, namely Southern England, Northern England and East Scotland, although it appears unrecorded for North Wales, West Scotland and Ireland. This aphid has been found in several countries in Europe on *J. communis*.

Cinara kochiana (Börner, 1939)

Giant larch aphid

(Text-figs. 5C, 14B, 14D, 16A, 29B)

Recent synonymy:

This species has been placed in the genus *Laricaria* by Heinze (1962).

Description:

APTEROUS PARTHENOGENETIC VIVIPARAE: LENGTH: 5.0–6.1 mm. ABDOMEN: Greyish brown or lead grey colouring. The dorsum of mature adults shows a distinct dark flecked patterning of scleroites, and there is usually a median longitudinal band on the dorsum. The muscle attachment plates and the siphuncular cones are small and black. Prepared specimens show that the scleroites bear short strong hairs. LEGS: Hairy, hind tibiae uniformly dark brown/black. HEAD AND THORACIC PLATES: Lead

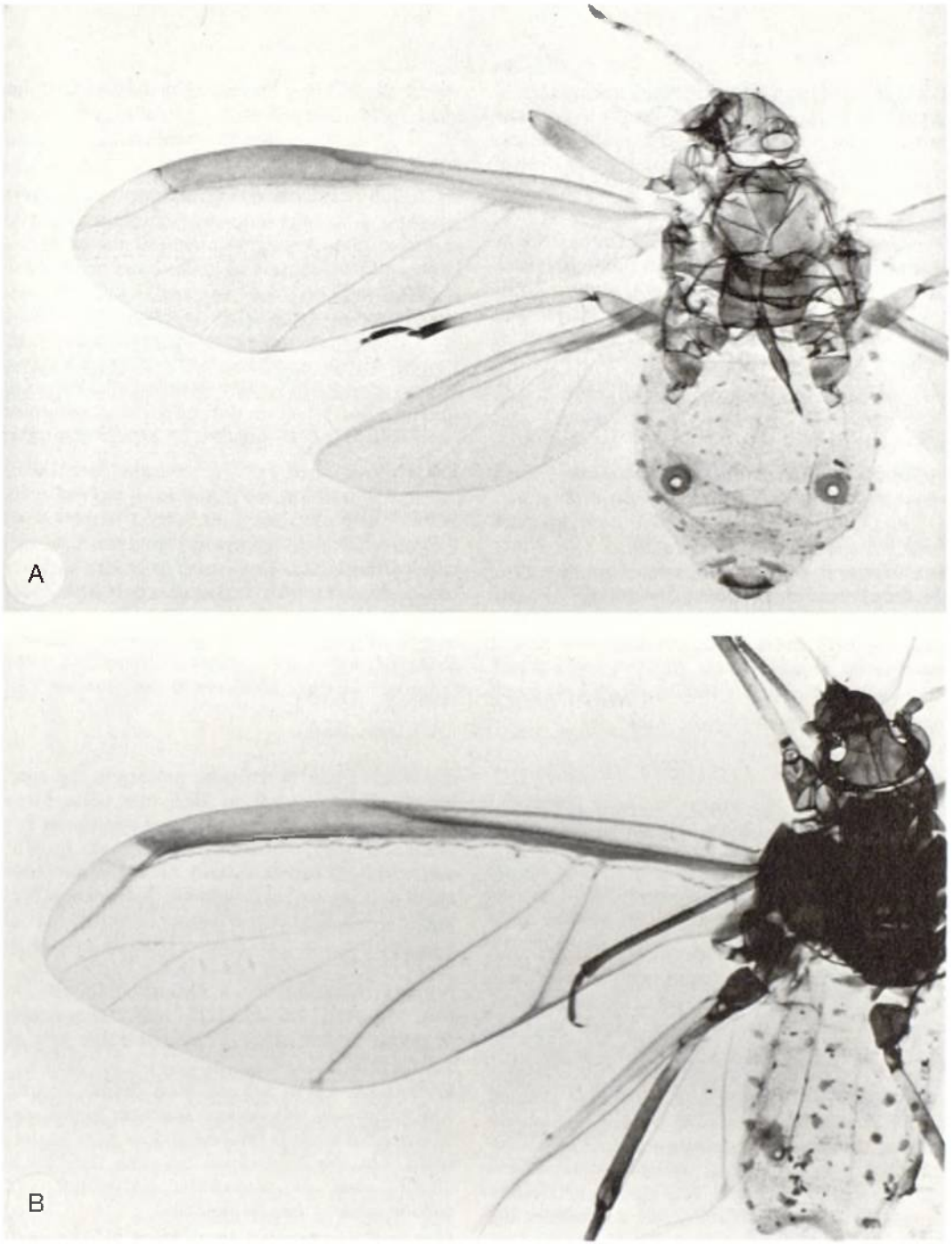

Figure 29.
A. Wing venation of *Cinara tujafilina*, B. Wing venation of *C. kochiana*.

grey colour; eyes black. ANTENNAE: Segments III–V mid-brown colour but blackened distally. There are numerous hairs present on the antennal segments, these are mostly shorter than their segment diameter. There are 6 sub-apical setae on segment VI. ROSTRAL LENGTH: 3.5 mm long.

OVIPARAE: Length 5.0–5.7 mm. Rather more elongate in form than viviparae, but body otherwise similar to viviparae. Hind sensoria on tibiae numerous, either polygonal or elliptical in shape and sometimes as elliptical pairs. There is no pericaudal wax ring.

MALES: Alate, wingspan 9.0–11.5 mm, body length 3.5–4.5 mm. The genitalia are prominent and heavily sclerotised.

EGGS: Dark yellow at first turning shiny black 1.5–2.0 mm long by 0.9 mm wide.

Host plants:

Larix decidua. It feeds in colonies in bark crevices on the lower part of the trunk, at the base of older branches and on large diameter roots, particularly where these are exposed by soil cracks or under loose forest litter.

Life history:

Recorded mainly from summer to late autumn in England. Apterous viviparae occur in colonies in the summer; alate viviparae have not yet been found. Both adult oviparae and males have been recorded in October. The oviparae occur in colonies but are also found with males on low branches. The eggs have been found deposited between the scales of woody cones on young larch trees. This species always appears to be ant attended; *Formica rufa* in the New Forest; while Breen (personal communication) has found *F. lugubris* to attend the aphid in Ireland.

Distribution:

England. Devon, Hampshire and Yorkshire, and more recently Co. Tipperary, Ireland. This aphid is rare and has been recorded from only a few parts of Western Europe.

Cinara laricis (Hartig, 1839)

(Text-figs. 5A, 16C, 21B, 22A, 28A)

Recent synonymy:

Cinara doncasteri Pašek (1953). According to Eastop and Hille Ris Lambers (1976) *Aphis laricis* Walker (1848) appears to be a synonym of this species.

Description:

APTEROUS AND ALATE PARTHENOGENETIC VIVIPARAE. LENGTH: 3.0–5.1 mm. ABDOMEN: Dark greyish brown; the dorsum is speckled with black, the apterae usually show a wax bloom coating. Prepared specimens reveal the speckling as irregular dark scleroites each possessing a stiff hair. There is much variation in the scleroite patterning ranging from a rather sparse speckling on the dorsum on some specimens to the opposite extreme of having larger (sometimes confluent) scleroites which reveal the inter segmental zones. The siphuncular cones are blackish and conspicuous, but sometimes the pigmented radius barely exceeds the diameter of the opening. LEGS: Rather short in the case of apterous adults. The femora and tibiae are dark brown or blackish for ⅓ to ½ of the distal portion. The tarsi are blackish brown. HEAD AND THORACIC PLATES: Dark and evenly pigmented. The sclerotisation of the metathorax has an irregular pattern in the apterae. WINGS: Winspan 9.0 to 10.5 mm. The forewing media vein is feint and in many specimens is only branched once. ANTENNAE: Yellowish brown but suffused with brown distally on segments III to V, some specimens have segment V brown as well as segment VI. Segment VI short (about ½ that of V) and convex on one side. There is only a short processus terminalis which bears 3 or 4 setae. The primary rhinarium has a distinct chitin rim. ROSTRAL LENGTH: 1.5 to 1.75 mm. There are six secondary setae which are paired either side of the rostral groove.

OVIPARAE: 4.0 to 5.0 mm long similar to apterae. The pericaudal wax deposit is absent in this species. The genital plate is bilobed and as wide as the anal plate. On the hind tibiae between the hair bases small, oval or somewhat polygonal shaped pseudosensoria can be detected.

MALES: Body length 2.3 to 3.4 mm. Wingspan 9.5 to 11.5 mm. Dark brown with black head, thorax and siphuncular cones. The scleroite pattern is variable, some specimens show lateral fusion; others have a regular pattern of circular areas along the dorsum. The antennae are blackish and have numerous

circular secondary rhinaria on segments III to V. The eyes are prominent, dark brown to black. The genitalia are heavily sclerotised.

EGGS: Yellow and shining when first laid, later turning dark brown, 1.3–1.5 mm long by 0.5–0.6 mm wide.

Host plants:

Larix decidua, L. kaempferi and the hybrid between these two *L.* x *eurolepis*. Most of the records of this aphid are from *L. decidua*. FEEDING SITE: On small diameter twigs on lower branches or the stem of young trees where it forms small dense colonies.

Life history:

Apterae first appear in May and continue to October but are most numerous in July and August. Alate viviparae appear in June, July and August, and have been taken in small numbers in suction traps. Oviparae have been found in small colonies in October together with males. The males have also been found in November but flight records are only for October. Egg laying has been observed in late October and early November. Eggs are deposited on any surface that is available even plastic plant labels or wooden stakes in a forest nursery. Ants in the genus *Formica* have been seen to attend the aphid colonies.

Economic importance:

This species is sometimes found on young newly planted trees where it can be very abundant. It is probably the honeydew from this aphid feeding on larch that has been recognised by European beekeepers as the "Lärchenmanne", since the honeydew of this species can sometimes be found in a candied state on the foliage. One of the characteristic sugars found to crystallise in honeydew is melezitose, taken from the French name for larch.

Distribution:

Occurs widely in Great Britain and mainly in relatively sheltered eastern counties where larch has been planted. These include Perth, Angus, Midlothian, Northumberland, Yorkshire, Hertfordshire, Hampshire and Kent. In the western forests it has been found in Cumbria, Herefordshire, Radnorshire and Glamorgan. It is known from the upland native European larch growing areas of Central Europe and possibly across Asia to Japan where it feeds on Japanese larch and *Larix russica*.

Cinara pectinatae (Nördlinger, 1880)

Green striped fir aphid

(Text-figs. 23A, 27A)

Recent synonymy:

Placed under the name *Neochmosis pichtae* (Mordwilko) in Kloet & Hinks (1945) check list. This species has also been known as *Buchneria pectinatae* in recent European entomological publications.

Description:

APTEROUS AND ALATE PARTHENOGENETIC VIVIPARAE: LENGTH: 3.9–4.4 mm. ABDOMEN: Bright green colour closely resembling the colours of European silver fir foliage. A diffuse paler green band runs down the mid dorsal region. There are similar marginal bands from the thoracic region extending to the siphuncular cones on the abdomen of apterae. The siphuncular cones are small and without dark sclerotisation. Sclerotised or pigmented patterns on the dorsum are also very weak and cannot be readily seen in a living specimen. Some prepared specimens show a speckling of small circular scleroites over the dorsum, each having a single seta. These setae are thicker and longer in the caudal and pleural areas. LEGS: Femora greenish brown; tibiae greenish or light brown; tarsi somewhat dusky. HEAD AND THORACIC PLATES: Pale brownish usually with a whitish wax bloom. Eyes are deep pinkish red. ANTENNAE: Pale brown. Segment VI elongate and parallel sided having long hairs below the primary rhinarium. The primary rhinarium on Segment VI has an indistinct rim; there are 3 or 4 sub-apical setae on the processus terminalis. ROSTRUM: Pale but heavily pigmented on R_3 to R_5. LENGTH: 1.2–1.6 mm long with about 7 secondary setae.

OVIPARAE: Yellowish green aphids 3.9–5.1 mm long. Hind tibiae with numerous small polygonal pseudosensoria, these are easily seen on a prepared specimen with phase-contrast illumination.

MALES: Alate, wingspan 9.2–11.6 mm, body length 0.28–0.4 mm. Head and thoracic plates dark brown (appearing black in living specimens). Scleroites are numerous and tend to become fused together on dorsum of abdomen to form up to 7 transverse

bands. Numerous secondary rhinaria on antennal segments III–V. Rostrum with 7 to 8 secondary setae. The genitalia are conspicuous and heavily sclerotised.

EGGS: Green with a dark speck at one end 1.6–2.0 mm long by 0.5–0.65 mm wide, laid singly on the needles of *Abies*.

Host plants:

Mainly recorded from *Abies pectinata* which is probably its original host plant species. This aphid has also been found regularly for a number of years on a Japanese species *Abies mariesii*, growing in this country. Only known from *Abies* spp, all the recorded host plants in Britain are essentially Eurasian, *(A. nepholepis, numidica, pindrow, sutchuenensis* and *veitchii* it has so far not been recorded from any North American species of *Abies* although these are widely grown.

Life history:

Eggs are laid singly on the foliage and have been found from early November. Little is known of the hatching date or the resulting spring generations but apterae have been found from June to September. It appears to be a solitary species, extremely difficult to see on account of its cryptic colouration and can usually only be found by jarring small branches over a sheet or tray. The presence of this aphid is sometimes betrayed by the predatory activities of wasps in the summer. The sexuales appear in October to early November.

Economic importance:

This aphid is regarded as a honeydew producer for forest beekeepers in Central Europe, and is probably the only aphid feeding on *Abies pectinata* that produces significant quantities.

Distribution:

Recorded from Hampshire, Surrey, Kent and Cambridgeshire in England and a single location in Morayshire Scotland. Although this species is widely recorded across Europe it does not appear to have been found to the east of Asia Minor.

Cinara piceae (Panzer, 1801)

Greater black spruce bark aphid

(Text-figs. 1, 4B, 5D, 7B, 8D, 18A, 27B)

Recent synonymy:

This species has been referred to as *Mecinaria piceae, Cinara grossa* (Kaltenbach) and *Neochmosis vanduzei* Theobald (1929). In a recent revision of this genus by Eastop (1972) he found some of the specimens assigned to *vanduzei* by Theobald to be *C. abieticola (C. confinis).*

Description:

APTEROUS PARTHENOGENETIC VIVIPARAE. LENGTH: Usually between 5 and 6 mm. ABDOMEN: Uniformly jet black resembling the texture and shape of old droplets of tar. The anterior portion is usually more shiny. The spiracular openings occur in a series of lateral depressions giving the abdomen a crenated profile. The siphuncular cones are small with a sclerotised area usually no wider than twice the diameter of the rim. Cleared specimens usually reveal very little overall sclerotisation on the abdomen indicating that the very dark body colour is sub-cuticular. Any hairs present on the dorsum are very inconspicuous and shorter or more or less equal to the diameter of the siphuncular opening. LEGS: Coxae and tarsi black. Hind femora coloured reddish brown and black distally. Tibiae also long and black with the proximal end reddish brown. The length of the hind femur and tibia together is greater than the body length. HEAD AND THORACIC PLATES: Evenly pigmented with a median longitudinal suture. ANTENNAE: Pale yellowish brown. Segments I, VI and the end of V darker. Processus terminalis very broad with 7–11 sub-apical setae. ROSTRAL LENGTH: 2.6 mm. Setae on R_4 in two rows totalling 10–20.

ALATE PARTHENOGENETIC VIVIPARAE: LENGTH: 5.0–6.5 mm. ABDOMEN: Similar in colour to apterae but narrower in shape and having larger siphuncular cones usually more than 2 diameters apart. LEGS: Similar pigmentation to those of the apterae. HEAD AND THORACIC PLATES: Heavily sclerotised and blackish. WINGS: Wingspan 14–18 mm. The forewings are broad and are tinted with a pale grey suffusion; the media is feint and branched twice; and the inner cubital vein meets a darkened edge on the hind margin. The pigmented stigma extends almost

Biometric data for apterous males of *Cinara piceae*

	Body length mm	Antennal segment length ratios				No. of secondary rhinaria on antennal segments				Number of Sub-apical setae	Rostral length mm	Number of Accessory Setae on R_4
		III	IV	V	VI	III	IV	V	VI			
i	3.7	2.48	1.17	1.69	1.00	0	0	1	0	7	2.25	13
		2.48	1.10	1.69	1.00	0	0	0	0	8		
ii	3.5	2.25	1.00	1.79	1.04	0	0	1	0	8	2.20	16
		2.21	1.11	1.79	1.00	0	0	1	0	6		

(Specimens from *Picea sitchensis*, Great Mell Fell, Troutbeck, Cumbria 26.10.73 collection number C.922.73).

half the length of the subcosta. ANTENNAE: Somewhat darker than apterae. Segment III has 8–15 circular sensoria.

OVIPARAE: 5.0 mm long. Apterous. Dark yellowish grey otherwise similar in life to apterous viviparae except that the adult has a prominent white area of wax at the posterior end of the abdomen. The hind tibiae are not swollen nor do they bear pseudosensoria as is the case in many species. The genital plate is enlarged and distinctly bilobed.

MALES: 3.5 and 3.7 mm long (2 specimens) apterous, and apart from being smaller they are slightly more elongate than other forms. The body colour is dark bluish grey, sclerotised areas shining black. Prominent black genitalia can be seen on prepared specimens.

EGGS: 1.5 to 1.6 mm long, black. Usually laid on basal half of needles on current year's growth. Several eggs may be laid on one needle. Usually certain shoots appear to be favoured on a tree while adjacent shoots although of the same age and appearance have no eggs on them.

Host plants:

Picea abies, P. asperata, P. brachytyla, P. breweriana, P. glauca, P. koyamai, P. omorika, P. sitchensis. It feeds on the branches, stems and trunks of all but the youngest spruce trees. It is usual to find dense colonies on the underside of branches away from the foliated parts and on the stem and trunk. Sometimes these colonies are so large that they partially cover the bark surface for several feet. The nymphs of the alate viviparae can sometimes be found away from the colony on the foliated branches where they moult and can presumably expand and harden their wings without becoming fouled with honeydew.

Life history:

Apterous viviparae have been found in April but become more plentiful in May. During late May and June large colonies occur on the stems and these have been found to be flourishing well into September. After this date colonies dwindle in strength until a final collapse in November. Alate viviparae appear chiefly in June and July and sometimes in August and September. Suction traps sampling at 12.2 m reveal rather small numbers of this aphid. Nevertheless the main period of flight activity appears to be June and July. Males have only once been found in Britain, but it is possible that as they are small and wingless they could have been overlooked. Those found were present on a stem colony on a young tree about 2 metres high. Oviparae are found from early September to November. They move out to the current years shoots to lay their eggs on the basal half of a needle. The needles of certain branches are often crowded with eggs. Although this species is recorded as being attended by wood ants this is not a necessary association as substantial colonies are often found on young spruce within recently afforested wet grass moorland.

Economic importance:

Usually it is just a few trees that support extensive colonies while neighbouring ones may be almost free. There are some observations indicating that where colonies have been feeding the bark showed signs of cracking and resin bleeding, and that on

older trees the feeding activities cause needle desiccation. In extreme case the photosynthate drain must be considerable. Infestation can be so heavy that the tree stem becomes dirty with saprophytic sooty-mould fungi growing on the honeydew excreted by the aphids. Wasps foraging for honeydew sometimes become a nuisance to forest workers. On one occasion the presence of such colonies in a stand being thinned was a severe nuisance as it made the handling of poles a repulsively slippery task. In certain European spruce forests this aphid is welcomed by beekeepers because it is visited by bees and provides an important source of forage in the alpine regions. The honeydew produces an excellent clear honey having a dark reddish colour (Fossel, 1960).

Distribution:

This species is of sporadic occurrence in Britain sometimes being abundant locally one year and apparently absent the next. It is often to be seen on solitary spruce trees in parks and gardens but seems equally at home in high elevation spruce forests at 400 m in South Scotland. Other records show it to have a wide distribution in northern Europe and extending into the mountainous regions of central Europe.

Cinara pilicornis (Hartig, 1841)

Spruce shoot aphid

(Text-figs. 5B, 21A, 26B, 30C)

Recent synonymy:

Cinaropsis pilicornis (Hartig) has been used by both Börner and Heinze (1957) and Heinze (1962). The name *Cinara pinicola* (Kaltenbach) has also been frequently used for this species in error.

Description:

APTEROUS AND ALATE PARTHENOGENETIC VIVIPARAE: LENGTH: 2.1 to 4.7 mm. ABDOMEN: Two colour forms are generally found, either predominantly a plain orange brown or a greyish green; small brownish siphuncular cones; the whole aphid clothed with numerous fine hairs and a dense mealy secretion. LEGS: Yellowish, distal half of hind femur darker, tarsi dark. HEAD, THORACIC PLATES AND EYES: Dark brown. ANTENNAE: Primary rhinarium on antennal VI without chitin rim; 3 or more usually 4 sub-apical setae on the processus terminalis. ROSTRAL LENGTH: 1.2–1.4 mm.

OVIPARAE: Apterous. ABDOMEN: Pale orange brown with distinct white pericaudal wax ring. LEGS: Pale brown. HEAD AND THORACIC PLATES: Rather pale brown.

MALES: Alate. LENGTH: 2 mm. ABDOMEN: Bluish green; but pale green when freshly placed in preservative and showing yellowish segmental patches. HEAD AND THORACIC PLATES: Yellowish brown to brown. EYES: Large and black. GENITALIA: Edged with black.

EGGS: Greyish covered with fine wax meal; laid on current year needles in rows or sometimes singly in close proximity.

Host plants:

Picea abies, P. albertiana, P. asperata, P. brewerana, P. obovata, P. omorika, P. likiangensis, P. sitchensis. In some years it occurs quite frequently on *Tsuga heterophylla.* FEEDING SITE: Invariably feeds on the youngest available branch shoots. In the spring it is active before bud burst and at this time forms small colonies on the undersides of woody shoots. As soon as the bud scales have fallen off the new shoots the aphids concentrate themselves among the new needles. It is in this part of the plant that the aphid is characteristically associated.

Life history:

The eggs are found from late summer to early spring and some begin hatching in early March before bud burst. The young aphids develop into apterous fundatrices which are larger (up to 5 mm in length) and somewhat darker than the eventual size of their offspring. Parthenogenic generations follow. Alate and apterous viviparae occur concurrently from late May to July. Eastop (1972) records that a higher proportion of viviparae are winged than in any other *Cinara* spp. Alate males and oviparae are produced as early as August and have been found up to early November. Pintera (1966) records that alate sexuparae appear when the forward feeding sites, the new shoots, become lignified. (The date that the host plant approaches this stage in Britain varies according to the prevailing summer weather.) The sexuales appear shortly afterwards. This species is not usually attended by ants in Britain. Earth covers made by ants are sometimes found in forest

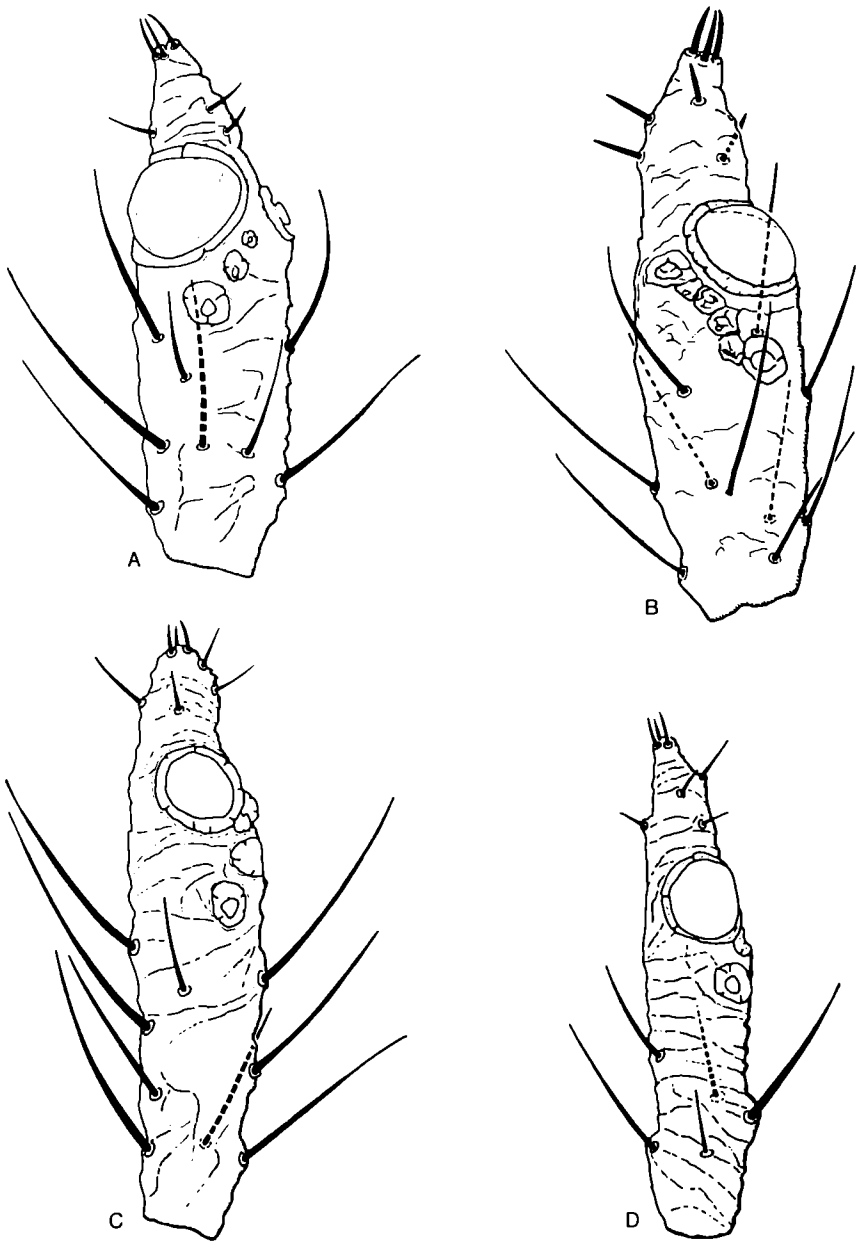

Figure 30. Antennal segments VI:
A. *Cinara pinihabitans* alate ♀, B. *C. pini* alate ♀, C. *C. pilicornis* alate ♀, D. *C. pinea* alate ♀.

nurseries up the stems of two-year-old trees to shoot colonies of the species. Pintera (1966) records *Myrmica* sp. making covers over colonies.

Economic importance:

This species is capable of producing copious quantities of honeydew in spring and early summer. This becomes particularly troublesome to nurserymen and Christmas tree growers in dry weather when sooty mould fungi grow and blacken the foliage. This can be severe enough to make the trees so black that they are unmarketable. There is also some evidence that this aphid will cause current year's needles to turn yellow and fall from the lower sides of the shoots that have supported colonies. It is possible that this reaction of the host plant to aphid colonies has been confused with a plant virus. Occasionally defoliation of the lower shoots occurs where honeydew deposits from infestations have been particularly heavy. The abundance of honeydew has been regarded as an important source of forage for beekeepers in mainland Europe. The chief period when bees work this source is between spring and when the new shoots start to become lignified.

Distribution:

Occurs widely over Great Britain on both *P. abies* and *P. sitchensis* and at least the western part of mainland Europe, possibly becoming less frequent further east. In some years it is extremely abundant among young spruce plantations. There are certain indications that in the recent past it was far less common than it is today eg Varty (1953) and Kurir (1964). Reasons for its widespread occurrence are possibly connected with its independence of ant attendance. This aphid is frequently found on newly afforested grass and heather moorland areas in high rainfall districts. Being a frequent nursery pest as well it seems likely that its dispersal has been aided by man's planting of dormant trees when the aphid is in an insignificant egg stage.

Cinara pinea (Mordwilko, 1895)

(Text-figs. 15A, 15C, 30D)

Description:

APTEROUS AND ALATE PARTHENOGENETIC VIVIPARAE: LENGTH: 3.1 to 5.2 mm. ABDOMEN: Broad and oval shaped. The colour is somewhat variable. The spring forms are often a light orange brown sometimes with grey blotches; the summer forms are grey or dark brown. There are small dark siphuncular cones. The scleroite plates at the base of many of the hairs (particularly on segments III–VI) are irregular, often confluent and of varying size. The maximum width of most sclerites is distinctly more than 50 μ maximum width. (The size and number of these are often reduced in the alate morph.) LEGS: In the early spring forms they are usually light brownish with the tarsi and distal ends of the tibiae black. Later generations often have a more extensive darkening of the legs: the femora and hind tibiae are sometimes freckled at the point where hairs arise. The tibiae hairs are fine and stiff usually between 1 and 2 times the greatest diameter of that segment. HEAD AND THORACIC PLATES: Brown to dark brown. WINGS: Venation often rather pale yellowish brown. Wingspan 10.2 to 11.2 mm. ANTENNAE: Pale brown, segment VI sometimes darker. Segments III to V bearing a few fine long hairs about 1.5 to 2 times the diameter of the segment. There are normally 4 sub-apical setae to the processus terminalis on segment VI. There is a distinct chitinised rim to the primary rhinarium on antennal VI. ROSTRAL LENGTH: 1.8 to 1.9 mm. There are usually five (sometimes 4 or 6) accessory setae on R_4. Segments R_3 to R_5 are usually dark brown.

OVIPARAE: Similar to the apterous viviparae and without a pericaudal wax deposit. The hind tibiae are slightly swollen and have numerous polygonal pseudosensoria between the pigmented bases of the setae.

MALES: Alate 3.2 to 3.6 mm long. Wingspan 9.4–10.7 mm. Some tendency for the scleroite plates to fuse on the VII abdominal segment.

EGGS: 1.56 to 1.66 mm long by 0.53 to 0.61 mm wide, black and shining and laid lengthwise along the axis of the needles.

Host plants:

Almost exclusively found on *Pinus sylvestris*, but occasionally *P. nigra* var. *maritima* and *P. contorta*. It is normally found apparently feeding amongst the foliated shoots of the current year's growth.

Life history:

The first adults are found between late March and

late May, these are apterae and presumably fundatrices. They are most often seen on the new extension shoots, the aphids closely resemble the orange brown colours of the scales between the developing needles. Subsequent generations during June and July appear to be either alate or apterous yet no sizable colonies are found. Alate forms are frequently taken in suction traps usually from early June to late August. Alate males start to appear by the end of August and are on the wing until early October. By far the greatest numbers of males flying have been taken in September. Oviparae have occasionally been found from September to November.

Economic importance:

Although this large aphid does not make extensive colonies, it produces honeydew in sufficient quantity to attract various ants and bees. In predominantly pine growing areas of Germany it is regarded as a useful source of honeybee forage.

Distribution:

Possibly the commonest and most widespread of all the pine feeding lachnids in Britain. Specimens have been collected from many afforested areas in Great Britain and Ireland as well as natural or semi-natural Scots pine woods in Inverness-shire (Stroyan, 1969) and the New Forest. It has been recorded in many European countries and Asia possibly following the range of its chief host plant. There are also a few records from North America.

Cinara pini (Linnaeus, 1758)

(Text-figs. 23B, 30B)

Synonymy:

The name *(Aphis) pini* L. 1758 has probably been used more often for other species of lachnids feeding on conifers than for the one here described from *Pinus sylvestris* growing in England. Eastop (1972) has pointed out the difficulties in disentangling the true indentities of previous records because of other closely related species. The aphids recorded from Britain have so far not included any sexuales. The males of *C. pini* are given as alate by Pintera (1966) and Eastop (1972). However, apterous males have been recorded from Holland and these have been assigned to a distinct (sub)-species *C. montanicola* Börner that has previously been found on *P. montana (= P. mugo).*

Description:

APTEROUS AND ALATE PARTHENOGENETIC VIVIPARAE: LENGTH: 2.5 to 4.4 mm (apterae); 3.2 to 3.3 mm (alatae). ABDOMEN: Dark grey or greyish green with black markings. A slight bronze iridescence can be seen where the body is not dusted with a mealy grey wax deposit. The adult apterae often show a well developed pattern on the dorsum consisting of a blackish central longitudinal lozenge shape which is divided by a thin pale grey longitudinal line. The anterior and caudal ends of the dorsum are usually dark grey and the prominent siphuncular cones are black and sometimes very conspicuous. The ventral surfaces are mealy grey. Early instars are more greenish, have less patterning and are without the mealy deposit. LEGS: Darkly pigmented at the joints and the distal regions and remaining portions pale. Alate viviparae are generally more heavily pigmented than the apterae. HEAD AND THORACIC PLATES: Dark greyish or brownish black having a bronze iridescence. WINGS: Wingspan 6.8 to 10.3 mm. ANTENNAE: There are usually 4 sub-apical setae on the processus terminalis. The primary rhinarium has a chitinised rim. The longest hair on segment III less than 2.8 times the basal diameter of that segment. ROSTRAL LENGTH: 1.4 mm. Accessory setae on R_4 usually 8 or 10.

SEXUALES: No males, oviparae or eggs have been recorded in Britain although they have been found in the Netherlands in September. The males in that case were apterous—a condition that is usually attributed to the sub-species *montanicola* Börner. The Dutch oviparae according to Eastop (1972:175) have inconspicuous pseudosensoria on the hind tibiae, and Börner (1949) lists the oviparae as being without a pericaudal wax ring.

Host plants:

Pinus sylvestris appears to be the usual host plant in Britain, and it has also been found on *P. contorta.* It is not clear whether the many other species of pine listed as host plants apply to the same race of *Cinara pini* that occurs here. Specimens have usually been found on foliated branches of pine.

Life history:

Both apterous and alate viviparae occur from May through to September. Being a rather uncommon species not many flying alatae have been taken in suction traps. The few that have occurred were chiefly in the June samples, with odd individuals in July. It could be that the large apterae collected in the New Forest in October and November are oviparae of this species. Out of 15 individuals although no eggs could be detected, only 1 adult had the developing stylets of a nymph within its abdomen.

Economic importance:

Specimens have been taken from branches of pine in Ringwood Forest, Dorset, that had yellowing foliage; Wood-Baker (1951) has recorded this aphid feeding near a resinous scar. It seems possible that both of these feeding sites may have been nutritionally favourable to the aphids.

Distribution:

Records indicate this is predominantly a Southern species. It appears to be long established in the New Forest, Hampshire and Cannock Chase, Staffordshire. There are scattered records across Europe presumably where *Pinus sylvestris* is able to grow. It is said to be more abundant elsewhere in Europe.

Cinara pinihabitans (Mordwilko, 1895)

(Text-fig. 30A)

Recent synonymy:

Cinara taeniata Koch has been used in recent European publications. It now seems, however, that the name *taeniata* has been used for several different species of *Cinara* including *pinihabitans* (see Eastop, 1972).

Description:

APTEROUS AND ALATE PARTHENOGENETIC VIVIPARAE: LENGTH: 3.1 to 4.6 mm. ABDOMEN: Apart from the reference by Pintera (1966) that the body is covered with wax, little is known about the appearance of living specimens. The scleroites are small or even absent on some alate aphids on segments 2 to 5. The hairs on the dorsum are long especially in the anterior region (140–180 μ). Specimens of *Cinara pini* can usually be distinguished by the shorter hairs in this region. Siphuncular cones quite conspicuous. LEGS: Dark brownish black. Femora with a pale area at the proximal end; tibiae with a pale area towards the proximal end. HEAD AND THORACIC PLATES: Dark brown to black. WINGS: Rather elongated forewing. The dark brown pigmentation of the stigma extends along the subcostal vein. Wingspan 8.3 to 10.5 mm. ANTENNAE: The segments III to V have long hairs and are darkened apically; segment VI is uniformly dark. The primary rhinarium on segment VI has a chitin rim. There are usually 4 sub-apical setae and 6 to 10 hairs on the base of segment VI. Secondary rhinaria on segment III of alatae are usually 4 or 5; IV 1 or 2; and V 1. ROSTRAL LENGTH: 1.3 to 1.5 mm. There are usually 4 or 5 secondary setae on R_4.

OVIPARAE: Specimens of oviparae with a distinct pericaudal wax ring are briefly described by Pintera (1966), and probably apply to specimens from Central Europe. Eastop (1972) mentions conspicuous pseudosensoria on the hind tibiae.

MALES: Alate, wingspan 11.2 mm; body length 3.5 mm (1 specimen). Otherwise similar to alate vivparae but with more pronounced oval or irregular sclerites in the mid dorsum region. Genitalia heavily sclerotised. Antennal segments III to VI dusky. Secondary rhinaria on segment III 75–98; IV 16–17; V 7–8; VI 0.

Host plants:

Pinus sylvestris and *P. uncinata*. According to Stroyan (1973) it is likely to be associated with branches of "old spreading pines of the kind found predominantly in the remaining stands of the old Caledonian forest".

Life history:

Alate viviparae have been taken from mid-May to mid-August. Mature apterous viviparae have been found in July and August. A single male was taken in a 12.2 m suction trap at Silwood Park, Berkshire, on 3rd October 1968. There appear to be no records of eggs or overwintering aphids in Britain.

Distribution:
On the basis of alate specimens caught in traps it appears that this species is uncommon yet widespread in England and Scotland. The only recent records of apterae are from Inverness-shire, Aberdeenshire and the New Forest, Hampshire.

Cinara pruinosa (Hartig, 1841)

(Text-fig. 25C)

Recent synonymy:

The name *Cinara (Lachnus) bogdanowi* Mordwilko, 1895 has recently been regarded as a synonym of this species (Eastop & Hille Ris Lambers, 1976).

Description:

APTEROUS VIVIPARAE: LENGTH: 2.4–5.0 mm; ABDOMEN: Dark green or brown, sometimes with a bronze metallic hue. Wax-meal markings laterally and sometimes weaker transverse lines occur. On the first three abdominal segments there is a blotchy blackish pattern resembling the letter omega, blackish blotches continue posteriorly. The very prominent siphuncular cones are blackish, they bulge out from the abdomen and are two diameters (or less) apart. LEGS: Tibiae dusky brown with hairs 0.10 to 0.15 mm in length. Femora paler but dark distally. ANTENNAE: Primary rhinarium on antennal VI with a chitin rim; four (or sometimes five) sub-apical setae on processus terminalis. Segment VI two-thirds the length of V. ROSTRUM: 2.0–2.2 mm long with usually eight accessory setae on R_4.

ALATE VIVIPARAE: LENGTH: 3.2–4.7 mm. Similar to apterae. The thorax and distal end of the tibiae are most heavily pigmented. It can be distinguished from *C. costata* in not having pictured wings and in having a double fork to the median vein of the forewing.

OVIPARAE: Adults are somewhat smaller than the viviparae and have a pericaudal wax ring present. LEGS: Hind tibiae swollen with numerous small pseudosensoria.

MALES: Alate. LENGTH: About 3 mm. Prominent black genitalia.

Host plants:

Picea abies, P. schrenkiana, P. sitchensis. FEEDING SITE: On shoots and twigs early in the year, and the base of trunk and roots in the summer. The aphids seem to favour shaded portions of the tree on which to feed.

Life history:

Eggs have been found on the bark of younger twigs. Overwintering apterae also occur on the roots living in chambers specially prepared by ants (Pintera, 1966). In the spring small colonies of apterae occur on the woody twigs. Alate viviparae occur from early June until August. The progeny of this alate generation are reported to develop on roots or near the base of the trunk of *Picea*. Apterae have been found on the roots in September. Oviparae have been found from September to early November in west Scotland and there is a single record of an alate male from Kent in October taken in a suction trap. These findings agree with records of this species from outside Britain. This aphid has been found attended by *Formica aquilonia* in Argyll, but in some other localities ants have not been found.

Distribution:

Rare in Britain, known from London, Surrey, Kent, Hampshire, Staffordshire, Mid-Wales, Newcastle, Angus and Argyll. Appears to be essentially a European species occurring in *P. abies* stands and thriving where there are wood ants.

Cinara schimitscheki Börner, 1940

(Text-figs. 19A, 31B)

Description:

APTEROUS AND ALATE PARTHENOGENETIC VIVIPARAE: LENGTH: 3.3 to 5.1 mm. ABDOMEN: Broad and somewhat flattened (in both apterous and alate forms), dark brown and covered with wax. Hairs on the dorsum arise from small ($< 50\ \mu$) dark and uniformly circular scleroites. Nearly all the hairs are distinctly curved and are directed posteriorly. The dark siphuncular cones are prominent and of

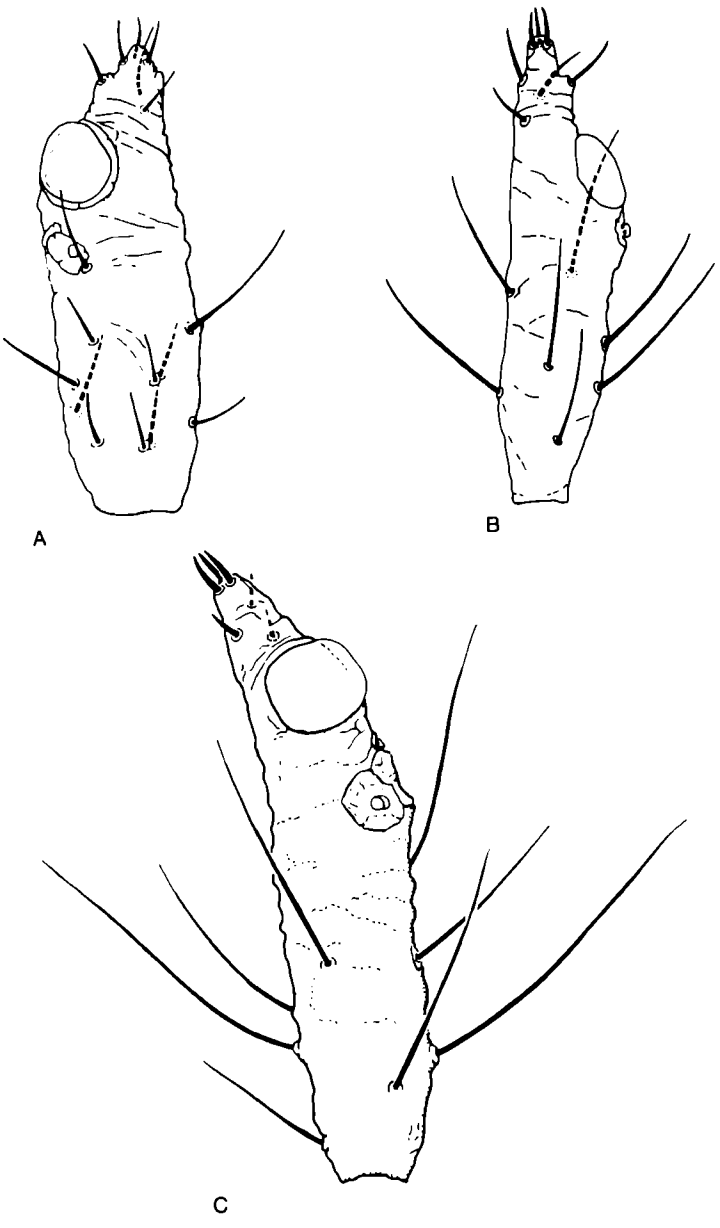

Figure 31. Antennal segments VI:
A. *Cinara stroyani* alate ♀, B. *C. schimitscheki* alate ♀, C. *C. tujafilina* alate ♀.

moderate size. LEGS: Hind femora and tibiae are almost black, at least for the distal half. HEAD AND THORACIC PLATES: Dark brown to black. WINGS: The pigmentation of the stigma continues along the length of the sub-costa. The media is branched twice and is feint, not appearing to connect with the sub-costa. Wingspan 10.0 to 11.9 mm. ANTENNAE: Segments III to VI with dusky suffusion at the apical ends, sometimes segments V and VI are totally suffused. There are usually four sub-apical setae on segment VI. ROSTRUM: Length 2.30 to 2.45 mm. Segment R_3 with dark bars along its length; segments 3 to 5 very dark. Accessory setae on R_4 usually 8 or more (sometimes 6).

Host plants:

P. nigra and *P. nigra* var. *maritima*. In central Europe Pašek is quoted by Pintera (1966) as finding this aphid on older branches under the bark. Börner (1940) mentions the habitat as twig apices of *P. austriaca (= P. nigra)*. The long rostrum would suggest that it is predominantly a bark feeder. It is also recorded from *P. mugo* in Europe.

Life history:

Incompletely known. Only viviparous forms appear to have been found. Apterae have been found in late May, late June and again in October. Alatae have been taken in suction traps sampling at 40 ft during June and early July.

Distribution:

This aphid has been found in the Botanic Gardens at Cambridge and at Kew. Alatae have appeared singly in suction trap samples from Newcastle to southern England on the eastern side of the country and also from Hereford and Long Ashton in the west.

Cinara stroyani Pašek, 1954

Green striped spruce bark aphid

(Text-fig. 31A)

Recent synonymy:

There is a possibility that several accounts of this species have been under the name *Cinara piceicola* (Cholodkovsky, 1896). *C. piceicola* is however not the same species but a synonym of *C. pilicornis* (Hartig, 1841). The confusion has probably arisen due to the close similarity between *C. stroyani* and *C. pilicornis*. Since Eastop's (1972) review of *Cinara* in Britain males of this species have been found. The fact that these are apterous and those of *C. pilicornis* are alate gives added support to the view that these are two different species and not ecological variants or forms of the same species.

Description:

APTEROUS AND ALATE PARTHENOGENETIC VIVIPARAE. LENGTH: 2.1 to 4.2 mm. ABDOMEN: Pale olive-buff colour with two longitudinal faint greyish green stripes along the positions of muscle attachment, plate pairs becoming darker at the anterior end. There are similar lateral stripes. The ventral surfaces are mealy. The siphuncular cones are somewhat variable, usually small and faintly pigmented reddish-brown in some specimens. Sclerotised areas on the dorsum consist of a transverse fragmented band on segments I to III and a more broken band on segment VIII. Sclerotised areas and diameter of siphuncular cones appear to be greatest in the spring. Alate forms show very little sclerotisation, their body colour is predominantly grey with transverse waxy bars on the dorsum; two dark green longitudinal stripes become evident when preserved in alcohol. LEGS: Dark brown with a proximal pale portion on the femora. The tibiae bear numerous fine hairs. HEAD AND THORACIC PLATES: Dark brown in apterae to almost black in alate forms. ANTENNAE: There are four (or rarely five) sub-apical setae on processus terminalis on antennal segment VI. ROSTRAL LENGTH: 1.4 in alatae to 1.7 mm in apterae. Segment IV usually with 8 or 9 secondary hairs.

OVIPARAE: Apterous and similar in appearance to the viviparae but small (about 2.5 mm long). The body colour is greyish having a mealy appearance and distinct white pericaudal wax deposit. Freshly preserved specimens have a pale orange brown ground colour with distinct longitudinal dark green markings. There is an enlarged genital plate. The head, thorax and siphunculae are dark brown. The legs are dark shiny brown. Some specimens show no signs of pseudosensoria on their hind tibiae, in others these can be seen.

MALES: 1.8 to 2.1 mm long (6 specimens). Apterous, and having a rather flattened elongate form.

Biometric data for apterous males of *Cinara stroyani*

	Body length mm	Antennal segment length ratios				No. of secondary rhinaria on antennal segments				No. of subapical setae	Rostral length mm	Number of accessory setae on R_4
		III	IV	V	VI	III	IV	V	VI			
i	2.00	2.50	1.00	1.11	1.00	13	7	3	0	3	1.3	6
		2.80	1.06	1.31	1.00	11	6	1	0	1		
ii	2.10	2.47	1.00	1.16	1.00	14	8	2	0	2	1.4	8
		2.37	1.00	1.05	1.00	7	6	2	0	3		
iii	2.05	2.37	1.00	1.26	1.00	13	8	5	0	3	1.4	5
		2.67	1.19	1.22	1.00	22	9	2	0	3		
iv	2.05	2.94	1.00	1.44	1.13	11	5	2	0	3	1.35	6
		2.26	1.00	1.11	1.00	6	10	3	0	3		
v	1.80	2.11	1.00	1.26	1.05	5	9	2	0	4	1.4	8
		2.16	1.00	1.26	1.05	4	4	1	0	4		
vi	1.85	2.11	1.00	1.16	1.00	9	7	1	0	4	1.4	8

(Specimens collected from *Picea abies*, Ross, Herefordshire 25/9/74, collection number C.976.74).

The body colour is green with markings that resemble the oviparae but they are blackish green and broader. The head, thorax and legs are a shiny black.
The genitalia are heavily sclerotised.

EGGS: 0.95 to 1.1 mm long. Butter yellow when first laid, turning a mealy grey colour. They are laid singly on the needles, Pintera (1966) states that up to three eggs are laid along a needle.

Host plants:

Picea abies, P. obovata and *P. sitchensis*. The insect lives on the underside of lignified shoots and to a lesser extent on the new growth.

Life history:

Little is known of the species in Britain. Large heavily pigmented apterae (possibly fundatrices) have been found in May. Colonies produce alate viviparae in late June. Pintera (1966) also refers to great numbers of these from May which after a colonising flight start colonies on current year's shoots. They may be obliged to feed there since their rostral length is shorter than the later generations which feed on thicker lignified shoots. Only apterous viviparae have been found in August, but by late September oviparae and apterous males have been found together. In early November oviparae and eggs have been found. In nearly all instances the colonies of this aphid have been found to be attended by *Formica rufa*.

Economic importance:

This species is listed as an important producer of honeydew which is used by honeybees as forage in the spruce forest districts of Europe.

Distribution:

This aphid is only rarely encountered in Britain. It appears to be well established in Herefordshire and in the New Forest where there are also wood-ant colonies. Other records are sparse and are possibly from short-lived colonies that have been founded by the spring alate dispersal. A few alatae are collected most years in the Rothamsted Insect Survey suction traps sampling at 12.2 m. It has wide distribution from Britain and Scandinavia through northern and central Europe.

Cinara tujafilina (del Guercio, 1909)

Thuja aphid

(Text-figs. 20D, 29A, 31C)

Recent synonymy:

This species has been placed in the genus *Cupressobium* by Börner (1940). In North America this species was previously known as *Cinara winonkae* Hottes (1934).

Description:

APTEROUS AND ALATE PARTHENOGENETIC VIVIPARAE. LENGTH: 1.7 to 3.5 mm long. ABDOMEN: The living specimens have been described by Bray (1953) as follows: "Apterous, viviparous, females on aerial portions of the plant are reddish-brown, with a pruinose covering that gives them a blue-brown appearance. Two longitudinal black stripes extend from the head over the thorax, diverging toward and nearly reaching the cornicles. Two dark-brown bands, one curved anteriorly and one posteriorly, extend from one cornicle to the other. Alate, viviparous, females are brown, and lack the pruinescence of the apterous forms. The two longitudinal bands are usually absent, but are sometimes present in the fall. The bands between the cornicles are light olive-brown. Nymphs and adults on the roots resemble the apterous females on the stems and branches, except that they are lighter in colour." Cleared specimens show the dorsum to be coated with numerous fine hairs. Scleroites are very small or absent in the alatae but may be present on the anterior segments. The siphuncular cones are pigmented but not very prominent. LEGS: Hind tibiae are dark at the distal end only. The longest hairs on the tibiae are about twice the diameter of that segment. WINGS: Somewhat dusky, the pigmentation of the stigma extends along the sub-costal vein and margin. ANTENNAE: As in other species in the *Cupressobium* group, there is no chitin rim to the primary rhinarium on antennae VI. There are 3 sub-apical setae on the processus terminalis of antennae VI. ROSTRAL LENGTH: 1.15 mm.

Host plants:

The host plants recorded for this species in Britain are *Thuja orientalis* and its variety *elegantissima*, and also *Chamaecyparis lawsoniana*. Other host plant genera all belonging to Cupressaceae, *Callitris, Juniperus, Calocedrus (= Libocedrus)* and *Widdringtonia* have been recorded outside Britain. The only member of this plant family native to Britain, *J. communis*, has not been recorded as a host. The feeding site appears to range from the foliated branch twigs and the undersides of branches near the trunk. Wound scars, cracks in the bark and closely adpressed branches are sites where this aphid aggregates. There are accounts of this species occurring on the roots in the summer (Bray, 1953).

Life history:

Apterae have only been collected from host plants in May, June and July. Two alatae have been taken in July and one in June with suction traps. Nothing is known of the overwintering behaviour in this country; in Israel the aphid reproduces parthenogenetically throughout the year. Sexuales are unknown in this species.

Economic importance:

This aphid is reported to have a marked effect on growth, even causing individual branches to die back. Being a colonial feeder there is much honeydew produced locally and subsequent sooty mould growths often spoil the appearance of trees grown as ornamentals. According to Bray (1953) roots that are infested instead of being a firm red colour become withered and dark brown and show die back symptoms, and the growth of repeatedly attacked roots result in a zig-zag appearance.

Distribution:

This species has only been found a few times in England. The records all fall south-east of line from the Severn to the Wash. Eastop (1972) has pointed out that this species is distributed much wider in the warmer parts of the world than most other species of *Cinara*, eg Mediterranean, The Middle East, South Africa, Australia and Southern USA.

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