The Auchenorrhyncha species were listed according to their host plants (or food plants during winter) and the plant associations; as an example for the diversity of insect communities in different plant associations, a selection of the most numerous species of the subfam. Typhlocybinae and Deltocephalinae (Cicadellidae), which live on grasses only, are given in the table (* = new for Switzerland). Other species of the remaining subfam. and families, developing on other plant groups or plants, cannot be listed here, but will soon be published in the above mentioned series of the Swiss National Park.

Resistance to leafhoppers and planthoppers in the world collection of rices

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Leafhoppers are major pests of rice throughout South and Southeast Asia and in Central and South America. They damage the plant directly by removing plant sap and transmit rice viruses. Because of their extreme importance as factors limiting rice production the International Rice Research Institute (IRRI) and national programs are breeding rice varieties with resistance to the leafhoppers and planthoppers. Screening programs in 15 countries in Asia and South America have identified different varieties with resistance to 10 leafhopper and planthopper species.

The key to improved varieties lies within the rices in the IRRI world germplasm bank that can withstand pests, diseases, adverse soils, drought and extreme temperatures. The Genetic Evaluation and Utilization Program (GEU) at IRRI gives priority to developing rice with genetic resistance to insects and diseases.

Tab. 1: Status of breeding for varietal resistance to planthoppers and leafhoppers at IRRI. January 1984.

Insects	Year screening started	Accessions tested	Accessions resistant	Percent resistant	Resistant breeding lines	Resistant varieties released
Brown planthopper *Nilaparvata lugens*						
Biotype 1	1967	30,790	281	0.91	+	+
2	1975	8,922	126	1.41	+	+
3	1975	10,711	148	1.38	+	+
Whitebacked planthopper *Sogatella furcifera*	1970	46,488	391	0.84	+	+
Green leafhopper *Nephotettix virescens*	1967	47,944	1,196	2.50	+	+
Zigzag leafhopper *Recilia dorsalis*	1973	2,370	36	1.52	+	-

The germplasm bank consisting of 60,000 accessions is being evaluated for brown planthopper, whitebacked planthopper, green leafhopper and zigzag leafhopper resistance (Table 1). Of the 47,944 accessions screened for green leafhopper resistance, 1,196 (2.5%) have been selected.

Resistant sources have been utilized as donors in the breeding program. Many of the 27 IR varieties (IR5 to IR62) have multiple resistance to several pests and diseases. IR36, the most widely grown variety of any food crop in the world, has resistance to four insects, four diseases and seven adverse soils. Because of the constant threat of insect biotype selection the wild rice collection is being evaluated in a search for new genes for resistance.

Colour paintings of Fulgoroidea and Cicadellidae

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Original paintings in water colours of Auchenorrhyncha of Europe and North Africa were shown as a poster, mostly species of difficult groups of which no colour pictures had been available up to now. In the discussions, it had been emphasized that good pictures of the habitus can be of substantial help in the exact determination of species. Shown were the following species:

Fulgoroidea:
Tettigometra beckeri HORV., *T. fusca* FIEB., *T. hexaspina* KOL., *T. impressifrons* M. & R., *T. leucophea* (PREISS.), *T. virescens* var. (PANZ.), *Brachyceps brachycephalus* (FIEB.), *B. laetus* (H. S.), *Eurychila decorata* (SIGN.), *Kelisia guttulifera* (KBM.), *Ditropis pteridis* (SPIN.), *Criomorphus albomarginatus* CURT., *Ribautodelphax albomarginatus* (FIEB.), *R. collinus* (BOH.).

Cicadellidae:
Acericerus heydeni (KBM.), *Idiocerus similis* KBM., *I. stigmaticalis* LEWIS, *Populicerus confusus* (FLOR), *Stenidiocerus poecilus* (H. S.), *Tremulicerus fuchsi* (KBM.), *Viridicerus ustulatus* (M. & R.), *Cicadula quadrinotata* (F.), *Dryodurgades dlabolai* WGN., *Metalimnus formosus* (BOH.), *Mocuelus quadricornis* DLAB.

Fifth Auchenorrhyncha meeting in Davos, Switzerland August 28-31, 1984

Objekttyp: **Appendix**

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Effect of neem derivatives on growth and fecundity of the rice pest Nephotettix virescens (Distant)

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Evaluation of different neem *(Azadirachta indica* A. Juss) derivatives showed potential to disturb growth and impair fecundity of the rice green leafhopper, *Nephotettix virescens* (Distant). Growth of first instar hopper nymphs was significantly reduced upon confinement to rice plants sprayed with 0.5–5% neem oil or 10–100 mg/kg neem seed kernel extract; systemic application of the extract was similarly effective at concentrations of 1–10 mg/kg. Furthermore, there was a significant correlation between duration of exposure to systemically treated rice plants and mortality of test insects. In a simulated field experiment, even after treated plants had been subjected to natural weather conditions for 1–6 days prior to infestation, neem derivatives (at 1000 mg/kg) significantly retarded growth of first instar nymphs.

When females were exposed to neem oil-treated rice plants or topically sprayed with the oil, fecundity was significantly reduced at concentrations $>6\%$. Longevity of the females was significantly affected only on treated plants using 25% neem oil. Also, short-term exposure of *N. virescens* to rice plants systemically treated with 5–50 mg/kg of a neem extract, significantly reduced fecundity but had no effect on longevity of treated females.

Taxonomic study of mango leafhoppers in Thailand

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Before this study *Idioscopus clypealis* (Leth.) and *I. niveosparsus* (Leth.) were the only two species of leafhoppers known from Thailand as important pests of mango.

Until recently, in October 1980, numerous typhlocybine specimens of *Amrasca splendens* Ghauri were collected on young mango leaves from Bangkla Chacherngsao, central Thailand. It was the first report of this species from Thailand.

One year later, several mango trees in flowering stage in different parts of Thailand had been surveyed. Another typhlocybine leafhopper, *Mangganeura reticulata* Ghauri was found for the first time in Chumphon province, southern Thailand.

In 1983 Dr. C. A. VIRAKTAMATH and the author made a taxonomic study of specimens of the genus *Idioscopus* from Thailand and found five species of leafhoppers attacking mango, including one new species.

At present, seven valid species of leafhoppers, attacking mango, from Thailand are listed as follows:

1. *Amrasca splendens* GHAURI, from Chacherngsao province
2. *Mangganeura reticulata* GHAURI, from Chumphon province
3. *Idioscopus clypealis* (LETH.)
4. *I. nagpurensis* (PRUTHI)
5. *I. clavosignatus* MALDONADO CAPRILES, from Chumphon province
6. *I. niveosparsus* (LETH.)
7. *I. chumphoni sp. n.* VIRAKTAMATH & HONGSAPRUG

Remarks: No. 1, 2 are typhlocybine leafhoppers,
No. 1, 2, 4, 5, 7 are new records of leafhoppers on mango from Thailand,
No. 3, 4, 6 are widely distributed and associated on the same tree,
No. 7 *I. chumphoni sp. n.* from Chumphon province, southern Thailand. This species is very similar to *I. niveosparsus* (LETH.) but differs from the latter by having different coloration and markings on face and in the structure of male genitalia.

I wish to acknowledge the help given by Dr. I. DWORAKOSKA and Dr. C. A. VIRAKTAMATH during this course of taxonomic work.

Studies of typhlocybine leafhopper species on sugarbeet in Pakistan

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Sugarbeet is grown in northern areas of Pakistan. It is attacked by a typhlocybine leafhopper species *Empoasca punjabensis* PRUTHI in Peshawar Valley. Biology of the species was worked out on poly B variety during May and June in semi laboratory conditions. Female laid 54–110 ($\bar{x}$ = 78.1) eggs and oviposited for 12–26 ($\bar{x}$ = 18.6) days. Eggs took 5-7 ($\bar{x}$ = 5.7) days to hatch. First instar nymph took 12–15 ($\bar{x}$ = 13.5) days to become adult with a total life history period of 17-21 ($\bar{x}$ = 19.1) days while 20.8% nymphs died during rearing out of 144 nymphs reared in laboratory. Male lived for 15-19 ($\bar{x}$ = 16.9) days and female for 13-31 ($\bar{x}$ = 21.1) days. Leafhopper species caused loss up to 14% in the yield. Three insecticides namely Marshal 20 E. C., Disyston 10 G and Furadan 3 G in 4 treatments were tried to control the insect pest. Marshal 20 E. C. proved better than the other insecticides. All the treatments have significant effect at 5% level in giving more yield while difference in the contents of Pol% and Bix% is statistically non-significant. So damage to the crop caused by leafhopper is significant and treatments are useful for crop and sugar contents.

Multivariate character analysis in neotropical ischnorhinine cercopids

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Compared with other superfamilies of the Auchenorrhynchous Homoptera the Cercopoidea are a neglected group, despite their economic importance within the tropics. Major problems exist in the classification of the group at all taxonomic levels, whilst keys for the identification of genera and species are much in demand.

The present work is an attempt to overcome these problems by the application of multivariate character analysis. As a preliminary check on the value of this technique as applied to the Cercopoidea the relatively small South American tribe Ischnorhinini, composed of approximately 60 species and 10 genera, has been chosen. Depending upon the results obtained the technique will be applied to some of the larger tribes and subfamilies within the Cercopoidea. The principal objectives of the work are to provide a clearer definition of the known genera and species and to determine their phylogenetic relationships.

As a first step in this work each of the 60 known species has been closely examined and a list of the variable morphological characters has been prepared. So far 120 such characters have been observed of which one half occur in the male genitalia. Others occur on the head (3 characters), vertex (3), frons (2), postclypeus (5), ocelli (2), antennae (2), rostrum (1), pronotum (11), scutellum (4), hind tibia (6), hind tarsus (4), tegmen (8) and wings (9). Whilst the majority of these characters display only two states, a few show a multiple state condition. Thirty-eight of the 60 known species within the tribe have so far been examined. Only two characters are common to all species and serve to diagnose the tribe, as previously noted by Fennah (1968). These are the marked lateral compression of the post-clypeus and the presence of a lateral post-clypeal ridge. The most important characters at the generic level appear to be the length of the rostrum, the form of the third antennal segment, the number of spines on the hind tibia and basal tarsal segment, the presence of a second anal vein in the tegmen and the form of the male genitalia. If the significance of these characters is upheld in subsequent computer analysis four new genera will have to be erected within the tribe increasing the number from 10 to 14. On the basis of the two tribal characters mentioned two genera will ultimately be transferred to the Tomaspidini and one genus of the latter transferred into the Ischnorhinini.

Attention is also being directed towards the three other Neotropical tribes within the subfamily (sensu Fennah 1968) in an attempt to ascertain the sister group of the Ischnorhinini. So far 19 genera and 76 species of the overall 38 genera and 340 species have been examined.

It will be some time yet before the present work, started in early 1984, will be finished but it is hoped that when completed it will provide a more rational classification of this tribe than hitherto available.

Fennah, R. G. 1968. *Revisionary notes on the New World genera of Cercopid Froghoppers (Homoptera: Cercopoidea).* Bulletin of Entomological Research *58* (1): 165–190.

Morphological characters of the larvae of cicadas (Homoptera, Auchenorrhyncha, Cicadoidea) and their taxonomic value

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Natural classifications of various groups of insects, mostly Holometabola, widely use both imaginal and larval characters.

Cicadas differ considerably from the most of Auchenorrhyncha in larval morphogenesis. The larvae gradually develop imaginal type characters (wing pads, genitals) along with soil adaptation features. The larvae differ from the imagines in structure of the integument and organs of vision and tactility and in the habitus. The chief differences lie in the structure of the limbs. The femur and the tibia of the forelimbs in the larvae are transformed into a half-nipper, serving as fossorial apparatus.

In the soil-dwelling larvae of a number of insect groups, the morphological structures, whose role is to develop adaptations to locomotion in the soil, are of a taxonomic value. With development of cicada larvae their fossorial limbs show augmented specialization. In the first larval instar the structure of the half-nipper is similar in different species. In the last pre-imaginal instar, the half-nippers of a similar structure are characteristic of the larvae of species falling into the same genus. Used as species diagnostic characters are the peculiarities of the chetotaxis of the larval head and limbs and also the sculpture and pigmentation of their tergites.

The imaginal diagnostics of genera and higher taxa is known to present much difficulty in cicadas. As exemplified by the larvae of the cicadas of the USSR, we have demonstrated that larval characters may be used to diagnose genera. Studies on the early stages of the larval morphogenesis may provide a basis for distinguishing supra-generic taxa. To solve some debatable problems of the Cicadoidea systematics comparative morphological analysis of the larval forms appears to be helpful.

The colour/pattern polymorphism of Philaenus spumarius (L.) (Hom., Aphrophoridae) in Britain

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The visible polymorphism of the spittlebug *Philaenus spumarius* occurs throughout the species range in Europe and North America. It has been intensively investigated by O. Halkka and colleagues in Scandinavia and Eastern Europe (e. g. Halkka *et al.,* 1974, 1975a, 1976). Of the eleven most common morphs (Fig. 1), eight are predominantly black (or dark brown) with varying amounts of lighter patterning; these may be referred to as melanics. Two of the three non-melanic forms, *typica* (TYP) and *trilineata* (TRI), have distinctive brindled and striped patterning respectively whereas the remaining morph, *populi* (POP) lacks patterning on its basic straw coloured background. Fig. 1 gives the abbreviated three letter names used to identify individual morphs, for full names see HALKKA, *et al.* (1973).

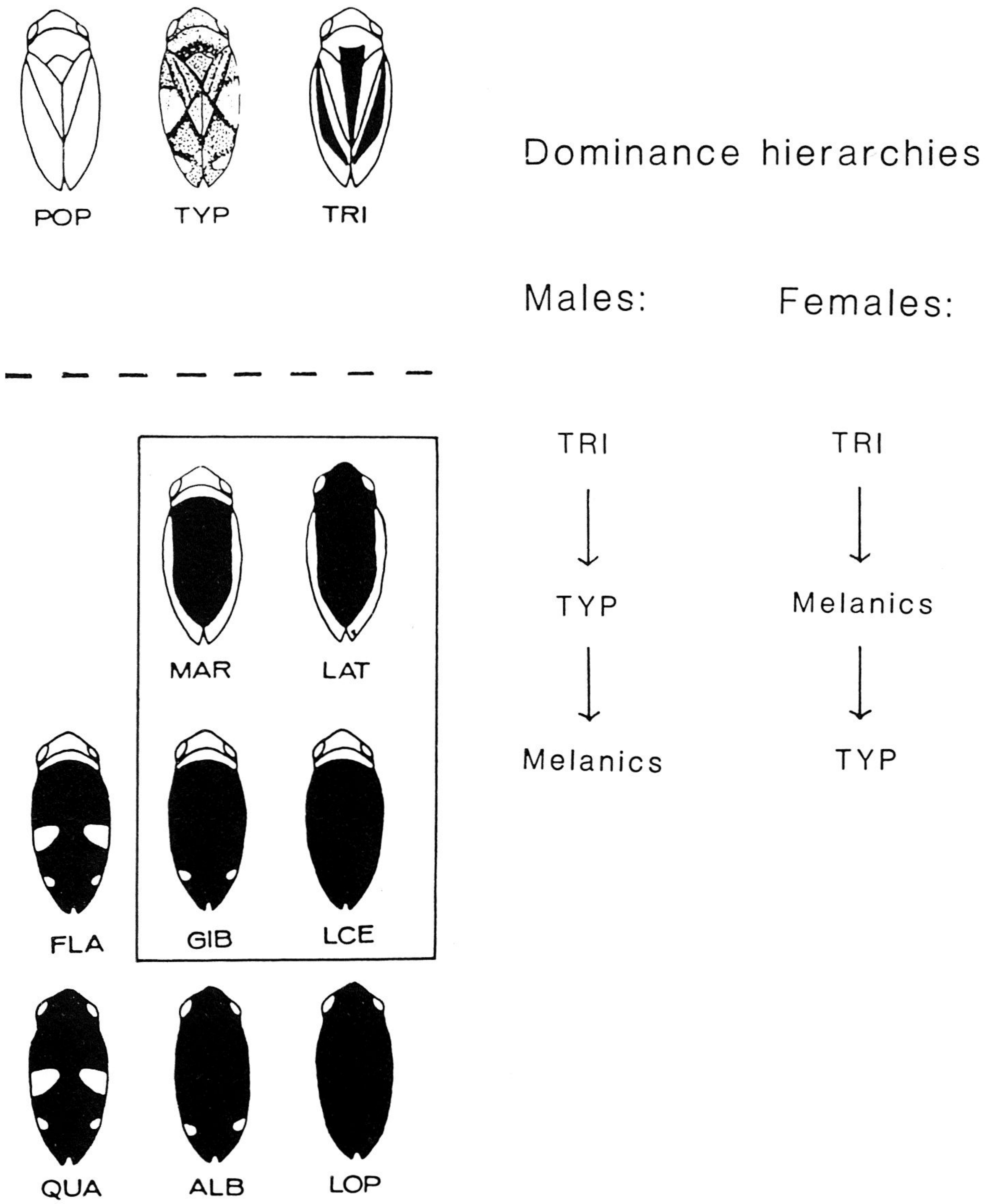

Fig. 1: Morphs of *P. spumarius*. Non-melanics above the dashed line, melanics below. Morphs limited to females in Scandinavian populations are enclosed within the rectangle.

Halkka *et al.* (1973, 1975b) have shown with Finnish material that the genetic control of the polymorphism is broadly due to a single locus with seven alleles. Two factors make the genetics more complicated, however. 1. Dominance differs between the sexes with TRI>melanics>TYP in females but TRI>TYP>melanics in males. 2. Four morphs (MAR, LAT, GIB and LCE) are, with few exceptions, female limited. Both of these features explain the lower frequencies of melanics among males in Scandinavian populations. Even among females the combined frequency of the eight melanic morphs rarely exceeds 20% in these populations and TYP is much the commonest morph. Nevertheless, large scale clines in melanic morph frequency are apparent in Scandinavian and E. Central Europe (Halkka *et al.* 1974, 1975a).

Until recently this polymorphism has received little attention in Britain. However, preliminary studies of geographic variation in morph frequency (Lees *et al.* 1983) suggest that in most localities TYP is the commonest morph but that the relative frequencies of TYP, TRI and the melanic morphs varies with type of environment. For example, urban samples have higher frequencies of melanic morphs and of TRI than samples from rural areas. One restricted area of South Wales, the Cynon Valley, is extreme in having frequencies of melanics (mainly LCE) much higher than observed anywhere else in the species range. Highest melanic frequencies there (>90%) are associated with intense but localised air pollution (Lees & Dent 1983).

British populations differ from those previously studied in Scandinavia and Central Europe in two further respects. 1. The female limitation of MAR, LAT, GIB and LCE is much less pronounced, especially of LCE. 2. Melanic frequencies rarely differ significantly between the sexes.

In recent and continuing work we have greatly increased our survey of morph frequencies in British populations and we have begun a breeding programme to investigate the genetic control of the polymorphism using British material. Our findings, although still incomplete, confirm our preliminary work and suggest the following:

1. Slightly increased frequencies of the melanic forms in large urban areas.
2. Clinal variation in the frequency of some morphs within England and Wales.
3. A reduction of female limitation in the morphs MAR, LAT, GIB and LCE.
4. That the dominance hierarchy is the same in both sexes with melanics dominant over TYP.

Halkka, O., Halkka, L., Hovinen, R. & Vasarainen, A. 1975a. *Genetics of Philaenus colour polymorphism: the 28 genotypes.* Hereditas *79:* 308–310.

Halkka, O., Halkka, L., Raatikainen, M. & Hovinen, R. 1973. *The genetic basis of balanced polymorphism in Philaenus (Homoptera).* Hereditas *74:* 69–80.

Halkka, O., Raatikainen, M. & Halkka, L. 1974. *Radial and peripheral clines in northern polymorphic populations of Philaenus spumarius.* Hereditas *78:* 85–96.

Halkka, O., Raatikainen, M. & Vilbaste, J. 1975b. *Clines in the colour polymorphism of Philaenus spumarius in Eastern Central Europe.* Heredity. *35:* 303–309.

Halkka, O., Raatikainen, M. & Vilbaste, J. 1976. *Transition zone between two clines in Philaenus spumarius* (L.) *(Hom. Aphrophoridae).* Ann. Ent. Fenn. *42:* 105–111.

Lees, D. R. & Dent, C. S. 1983. *Industrial melanism in the spittlebug Philaenus spumarius* (L.) *(Homoptera Aphrophoridae).* Biological Journal of the Linnean Society *19:* 115–129.

Lees, D. R., Dent, C. S. & Gait, P. L. 1983. *Geographic variation in the colour/pattern polymorphism of British Philaenus spumarius* (L.) *(Homoptera: Aphrophoridae) populations.* Biological Journal of the Linnean Society *19:* 99–114.

The biological records scheme for British Auchenorrhyncha

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The Biological Records Centre is interested in collecting and collating records of various species of animals and plants in Britain, including the whole of Ireland and the Channel Islands. One of the principal uses of these data is the preparation of distribution maps of various species, dividing the country into ten kilometer squares. Another use that has been made in recent years is the comparison of records collected over different time-periods to find contractions or expansions in range of certain species.

The scheme for Auchenorrhyncha was started by KEITH PAYNE in 1979. Unfortunately, after three years he had to give it up due to ill-health and I volunteered to take over the scheme on a temporary basis. Records are based on either the British National Grid or Irish National Grid.

The main scheme uses a large computer at Cambridge, but I have been able to produce my own maps on a home microcomputer. Those for *Philaenus spumarius* (L.) and *Criomorphus albomarginatus* CURT. essentially illustrate the limited capabilities of the approximately thirty recorders on this scheme. Other species, such as *Criomorphus williamsi* CHINA, *C. moestus* (BOH.), *Issus coleoptratus* (FAB.), *I. muscaeformis* (SCHRANK), *Cercopis vulnerata* ROSSI, *Athysanus argentarius* METCALF and *Eupteryx filicum* (NEWMAN) obviously have more limited distributions: *I. coleoptratus, C. vulnerata* and *A. argentarius* have a south-easterly distribution, while *E. filicum* has a south-westerly. *C. moestus* and *I. muscaeformis* have limited distributions in the North of England and *C. williamsi* is found in an inland area towards the South-East of England.

Spiroplasmas in leafhopper vectors: multiplication and pathogenicity studies

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Spiroplasmas are now being found in insect species of many orders, and may eventually prove to be common microorganisms associated with arthropods in warmer climates. They occur as internal parasites of blood and tissues, as inhabitants of the gut and possibly as external contaminants. Spiroplasmas interact with insects in many ways; some, e. g., the sex ratio organism, have very complex relationships and not only are they transmitted through the egg to the next generation but they also eliminate only the male progeny. Others such as the plant pathogens *Spiroplasma citri* and the corn stunt organism (CSS) must pass through the insect and be re-introduced into the plant during feeding (MARKHAM, P. G., Yale J. Biol. Med. *56:* 745–751).

Some spiroplasmas are found in the insect or in phloem tissue of plants, and multiply in both hosts. Others may survive for many days on the surface of plants and invade the gut or even the haemolymph of the insect to multiply. Most spiroplasmas regardless of ecological origin, are thought to multiply well in haemolymph of inoculated insects. Only a few spiroplasmas, e. g., the plant pathogens, have the ability to penetrate the tissue of insects. But some may enter via damaged tissue. The invasion of the haemolymph seems to evoke an immune response in leafhoppers.

Insect extract is inhibitory to the growth of spiroplasmas. The active component is present in healthy insects and is heat stable, although it has not been purified. Insects challenged by injection with spiroplasmas produce approximately 5 to 6 times more haemocytes. *S. citri* and CSS often decline in numbers following inoculation into leafhoppers before rapidly increasing, reaching maximum titres equivalent to 10^9 colony forming units (cfu) per ml. *S. citri* gradually disappears from the blood of the experimental vector *Euscelidius variegatus* (Kbm.), even though the total number of viable organisms may be increasing or at a high titre. But with CSS the spirals are detectable in the haemolymph at all stages of infection.

Pathogenicity is not simply a characteristic of a particular organism. It also depends on the interaction with the vector, the dose and the environmental conditions, such as temperature. *S. citri* is non-pathogenic or produces a non significant increase in mortality in *E. variegatus* regardless of initial inoculum. CSS is non pathogenic to its main vector *Dalbulus maidis* (DeL. & W.) but pathogenic to several other *Dalbulus* species (Madden, L. V. & Nault, L. R., 1983, Phytopath. *73,* 1608-1614). Some *Cicadulina* species appear to tolerate and may eventually eliminate CSS following infection and the longest surviving insects were those which had transmitted. Leafhoppers infected with honey bee spiroplasma, BC3, were killed within 8 days when injected with a dose containing 10^5 cfu but showed no significant effect when injected with 10^2 cfu, even though the maximum titre reached in the insects was the same in both treatments (10^6 cfu). Haemolymph extracted from insects challenged with a low initial titre when spotted on to agar prevented the growth of *S. citri* lawns. Rapid growth occured in *S. citri* inoculated plates and on lawns inoculated with extract from insects injected with sterile medium.

During the normal acquisition process spiroplasmas are acquired gradually so it would be expected that the immune system would respond fully. The insects immune response system may therefore be one of the many factors which play a role in determining the species which are efficient vectors of pathogens.

The transmission of maize streak virus by leafhoppers, a new look at host adaptation

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Maize streak virus (MSV) is a disease of grasses which readily infects monocotyledenous crops such as maize, sugarcane and cereals. It is reported to occur as host adapted strains (BOCK, K. 1974. Common. Mycol. Inst./Assoc. Appl. Biol. No. 133.4 pp; AUTREY, L. J.-C. & RICAUD, C. 1983, 277–285, in Plant Virus Epidemiology, ed. PLUMB R. T. & THRESH J. M., Blackwell.). MSV is transmitted by *Cicadulina,* leafhopper species, in Africa and parts of Asia (ROSE, D. J. W. 1983. Proc. 1st. Intern. Workshop on Auchen. 297–304. Common. Agric. Bur.).

STOREY pioneered most of the work on the vector-virus relationships of the disease in East Africa (reviewed by ROSE, D. J. W. 1978, Annu. Rev. Entomol. *23:* 259–282). We have recently been comparing MSV isolates, from both grass hosts and crops, which have been obtained from several different countries (Nigeria, Dr. H. W. ROSSEL; Egypt, Dr. E.-D. AMMAR; Kenya, J. THEURI; Burundi, Dr. R. H. MARKHAM; & Mauritius, Dr. L. J.-C. AUTREY). MSV probably also occurs as mixtures of strains, since "strains" expressing different symptoms can be selected from a single infection. The original and selected strain continue to give consistent symptoms. The interactions are also being studied between MSV isolates and numerous leafhopper species, including *Cicadulina mbila* (NAUDÉ), *C. chinai* GHAURI, *C. bipunctella* MATS., *C. triangula* RUPPEL, *Dalbulus maidis* (DEL. & W.), *Macrosteles sexnotatus* (FALLÉN), *Circulifer tenellus* BAKER all of which are grass or maize feeding species.

Biological assay, injection of virus and membrane feeding techniques have been used, combined with a new technique for assaying virus in the insect by using a radiolabelled complementary DNA probe to the virus. The data suggests that the virus occurs as several different strains varying, but consistently, in symptom expression. In the chlorotic areas the virus occurs in all leaf cells from phloem to epidermis. Replication occurs in the nucleus but free virus is available to the vectors outside the nucleus. Strains of MSV vary in symptoms from mild yellow streaks and chlorotic spots to stripes and sometimes the entire leaf may appear white. Stunting may occur and some grasses may produce proliferation and growth abnormalities. Other symptoms may occur in maize, such as severe stunting, vein swelling and enations along the veins, but these are caused by feeding damage which is associated with several species of *Cicadulina,* probably as a result of a toxin.

The vectors play the major role in determining host ranges. There is no evidence that the virus multiplies in the vector, therefore the quantity of virus in the insect is crucial in relation to transmission. *C. mbila* is the most efficient vector (STOREY's "active" race) which can acquire MSV in seconds and transmit in minutes, but this will depend on the availability of the virus in the plant, and the dose acquired. The proportion of vectors within test samples of *C. mbila* varied between 60–100%. *C. triangula* and *C. bipunctella* were inefficient vectors and usually only 5–15% transmitted. More than 1000 *C. chinai* were tested but failed to acquire then transmit MSV. *C. triangula* and *C. mbila* both transmitted following acquisition from membranes. As reported by STOREY, there does appear to be a barrier to absorption within the insect, which may be overcome in some cases by injection. Following injection of virus *C. mbila, C. triangula* and *C. chinai* transmitted efficiently, but *Dalbulus maidis* was inefficient. Using this technique all "strains" could be transmitted to maize, cv. Golden Bantam, regardless of their geographic origin or original host. Thus isolates from maize, coix, paspalum, setaria, sugarcane, panicum and other grasses could be transmitted to maize.

The sugarcane delphacid, Perkinsiella saccharicida (Homoptera: Delphacidae) in North America

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The sugarcane delphacid, *Perkinsiella saccharicida* KIRKALDY, was discovered in a Florida sugarcane field on August 4, 1982 by Dr. OMELIO SOSA, JR. The original collection was made on sugarcane, *Saccharum officinale,* approximately 22 km west of West Palm Beach, Florida. Identification was made by Dr. JAMES P. KRAMER, USDA Systematic Entomology Lab., U.S. National Museum, Washington, D.C. *P. saccharicida* originally occurred in Java, Formosa, southern China, the Malay States and Australia. It has been introduced into the Hawaiian Islands, Mauritius, Réunion, Madagascar, South Africa, Ecuador, and Peru, and of course, Florida.

Surveys conducted in September and October 1982 quickly revealed that sugarcane delphacids were present in most sugarcane fields in southern Florida. To date, the populations have remained below economic levels, and no insecticide treatments have been formally recommended. Instead, the emphasis has been on biological control. The predatory mirid, *Tytthus (= Cyrtorhinus) mundulus* (BREDDIN) was considered the most successful biological control agent introduced into Hawaii to control the sugarcane delphacid. It has been introduced into Florida sugarcane fields 4 times in the last two years. The colonies were obtained from Hawaii and were kept in quarantine for one generation before release. So far, about 500 individuals of *T. mundulus* have been released, but no specimens have been recovered in the field. Already established in Florida are *Tytthus parviceps* (REUTER) and a mymarid egg parasite, *Anagrus* sp. It is hoped that the combination of biotic factors, weather and cultural practices, will keep the delphacid populations at or below the present levels, and that the heavy damage reported in Hawaiian cane fields circa 1900 will not be repeated in Florida. Peak populations of the delphacid do not occur in Florida until October. At that time, the sugarcane has completed the maturity of its growth and harvesting begins. This may account for the low economic impact.

This delphacid is a double threat insofar as high populations can cause severe economic damage to sugarcane, and secondly, it is a vector of Fiji disease, a reovirus not reported in the Western Hemisphere but known from Asia and Africa and still a problem on cane in some areas, particularly Australia.

In 1982, surveys revealed the sugarcane delphacid in 10 southern Florida counties. In 1983, it was discovered in 14 more counties in central and northern Florida, plus one locality in extreme southeastern Georgia near the Georgia-Florida border. Nearly all these records were obtained in late summer to December when the delphacid populations increase and seem to have an instinctive urge to disperse. There are literature records of the delphacid 30 km from land over ocean water. In northern Florida there are no large commercial fields, the cane is grown in small patches for grinding into molasses. There is concern that the delphacid will disperse to other sugarcane growing areas of southern Mississippi, Louisiana, and Texas. Florida sugarcane has become a major agricultural industry with total value over 1 billion dollars per year and jobs for approximately 25,000 people. Florida sugarcane production has now surpassed Hawaii, with Florida producing 1.2 million metric tons of raw sugar last year. The presence of this delphacid and its capability to vector the Fiji disease virus makes the introduction and establishment of this disease more likely. Therefore, there is need to keep the vector population at the lowest level possible to protect the important sugarcane industry in Florida and other states in North America.

New concepts in classification of the Flatidae

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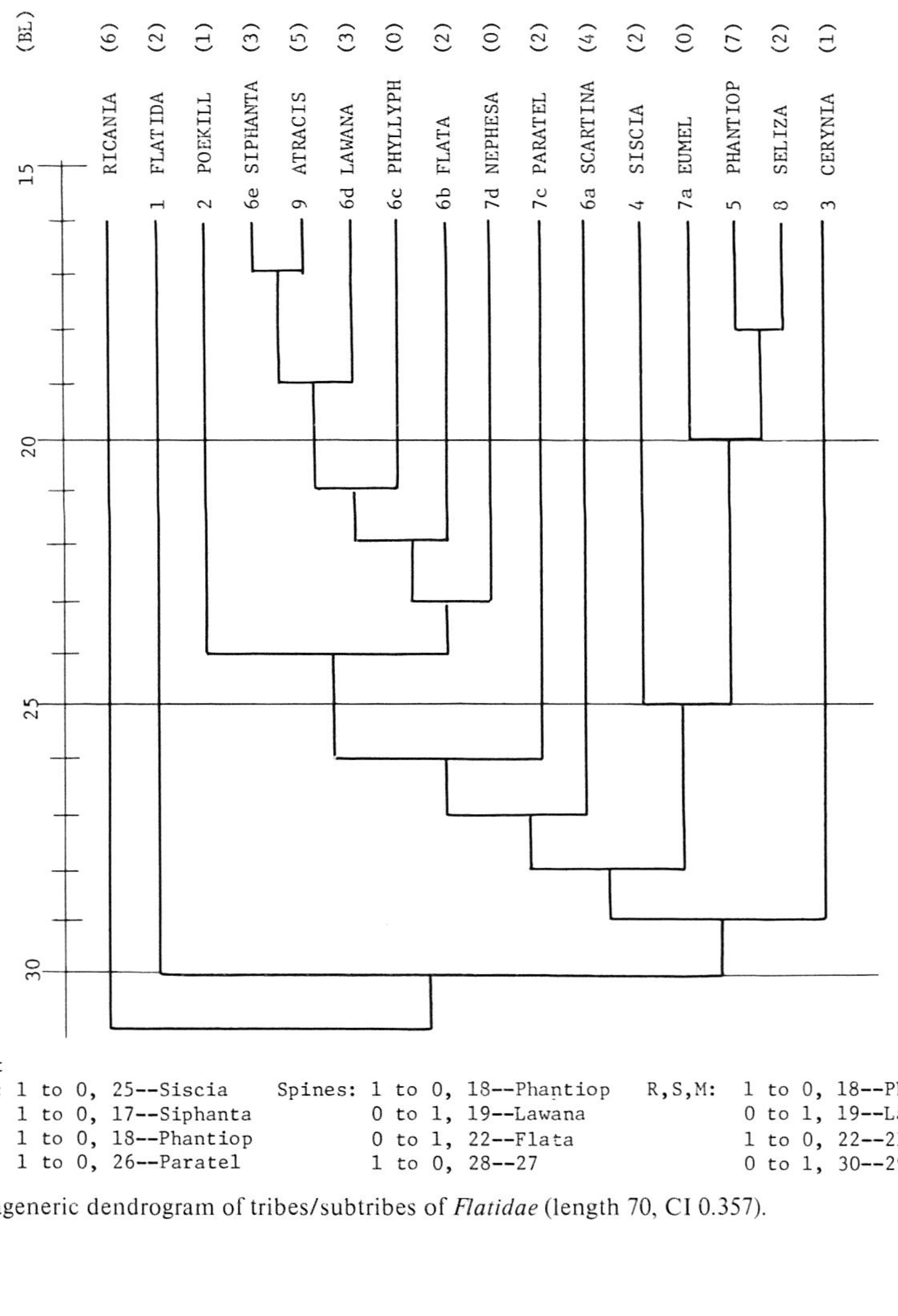
A preliminary study of supra-generic relationships in the Flatidae was done with a Fortran 77 computer program for Phylogenetic Analysis Using Parsomony (PAUP). This program was developed by D. L. Swofford, Illinois Natural History Survey. The operational taxonomic units were 15 genera representing the tribes and subtribes in the Metcalf Catalogue, and a member of the Ricaniidae used as an outgroup to root the tree. Other studies were made on 65 genera within the tribes and subtribes.

Twenty-five characters were selected for binary coding of character states. These included shape and structure of the head and tegmina, carinae, venation, metatibial spines, length of antennae and type of ovipositor. To give a few examples, the head can be produced or truncate, the metatibiae are unispinose or bispinose, veins R, S and M arise from the basal stem or S arises from R at a varying distance from the basal stem, vein Cu is branched or unbranched, a submarginal apical line of crossveins is present or absent, and the inner valvulae of the ovipositor are either bladelike or modified. Twelve of the characters applied to the tegmina.

In Australia and New Guinea, 96 percent of the genera have one preapical posttibial spine, and nearly all genera have a modified ovipositor.

The supra-generic tree (Fig. 1) showed branching relationships that could be reconciled with conventional classification, except that unexpected closeness was shown between *Siphanta* and *Atracis,* and *Eumelicharia* and *Seliza.* In general, the genera with broadly rounded tegmina, two posttibial spines, R, S, and M arising together, and a bladed ovipositor, e. g., *Flatida, Poekilloptera* and *Cerynia,* occupied a basal position on the tree. Reversals of character states and a relatively low consistency·index (0.357) indicated a high degree of homoplasy.

The analysis of genera within tribes showed that the Nephesini and Cryptoflatini do not have natural groupings of genera.



Change list

Ovipositor:	1 to 0, 25--Siscia	Spines:	1 to 0, 18--Phantiop	R,S,M:	1 to 0, 18--Phantiop
	1 to 0, 17--Siphanta		0 to 1, 19--Lawana		0 to 1, 19--Lawana
	1 to 0, 18--Phantiop		0 to 1, 22--Flata		1 to 0, 22--21
	1 to 0, 26--Paratel		1 to 0, 28--27		0 to 1, 30--29

Fig. 1. Suprageneric dendrogram of tribes/subtribes of *Flatidae* (length 70, CI 0.357).

Evaluation of eight synthetic pyrethroids for delphacid and cicadellid pest control on rice

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Cypermethrin (Cymbush and Ripcord), deltamethrin (Decis), fenvalerate (Sumicidin), permethrin (Ambush), and three coded compounds (FMC 54800, MTI 11500, and WL 085871) were evaluated at 12.5 g ai/ha (deltamethrin) to 25–100 g ai/ha (others) in the field in 1983 wet season. Against *Nilaparvata lugens* (STÅL) and *Sogatella furcifera* (HORVÁTH) (Delphacidae), MTI 11500 showed the lowest population. Against *Nephotettix* spp. (mainly *N. virescens)* (DISTANT) (Cicadellidae) deltamenthrin & WL the best. Against other pests (whorl maggot, deadhearts, leaffolder, and rice bug), deltamethrin is the best.

On the dormancy forms of Auchenorrhyncha

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To overcome unfavourable conditions in the seasonal course of weather Auchenorrhyncha use rarely migrations but rather dormancy as a restriction of the energetic expensive functions of metabolism by retardation or even stop of the ontogenetic development. This can be obtained by two different ways: either consecutively as an obligatory consequence of already detoriated environmental conditions or prospectively more or less long before these occur after an announcing signal only.

The basic mechanism of consecutive dormancy is quiescence as a consequence of the van't Hoff's law. At constant 20 °C *Euscelis incisus* (KBM.) may perform 6 generations per year, in the open only 2 to 4 according to the latitudinal performance of temperature. Their larvae, hibernating in quiescence, can be caused to continue their development at any time by higher temperatures.

In the consecutive dormancy of oligopause the reaction to unfavourable conditions is more or less delayed, as an accumulation of the insufficient valences of the inducing factors is necessary and at last may be overcome in these too. Short photophases retard the larval development of *Laodelphax striatellus* (FALLÉN) at first in a later stage. The females of *Muellerianella brevipennis* (BOH.), grown up in short days, produce only diapausing eggs, but transferred to a long day regime they lay nondormance eggs after 2 or 3 weeks.

In the prospective forms of dormancy, diapause and parapause, always two different factors are effective: an initiating one and a terminating one. In diapause the reaction of the organisms are facultatively depending on the valences of the effecting factors. In short days the females of *Macrosteles sexnotatus* (FALLÉN) produce exclusively eggs with an embryonic diapause, only terminated by a period of chilling, but in long days they lay nondormance eggs. Such photoperiodic regulation of egg diapause restricts many potential polyvoltine leafhoppers as *Turrutus socialis* (FLOR), *Jassargus obtusivalvis* (KBM.), *Arthaldeus pascuellus* (FALLÉN) and others in Central Europe to 2 or 3 generations.

In parapauses the dormancy occurs obligatory in an endogenous fixed phase of the ontogenesis and by this often guarantees monovoltinism, as for instance in the ovarial development of *Stenocranus minutus* (FAB.) and *Mocydia crocea* (H.-S.), which can produce eggs only after they had experienced a short day period. In a continuous long day regime they never oviposit. In a similar manner *Agallia brachyptera* (BOH.) and *A. venosa* (FOURCROY) as *Mocuellus metrius* (FLOR) demand obligatory a period of chilling after the invagination of the embryo.

Thus the dormancy forms in first line serve as ecological means to overcome unfavourable environmental conditions indeed, but in the same time they synchronize the ontogenetic phases within the populations, especially the sexual partners, and moreover support a chronological displacement of the density peaks within members of the same guild in the biocoenosis.

Biotaxonomy of the birch feeding Oncopsis flavicollis (L.) species complex

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Populations of *Oncopsis flavicollis* (L.) associated with birches, *Betula pendula* ROTH and *B. pubescens* EHRH. were studied from the southern British Isles (South Wales and South-West England).

Three sibling species are now recognised and are here termed species 1, 2 and 3 until the correct nomenclature has been established.

The following techniques have been used to investigate the taxonomy of the group.

1. Morphological (male abdominal Apodemes).
2. Acoustic Behaviour (Species Specific Calls).
3. Female Colour Polymorphism (Frequency and Distribution).
4. Morphometric methods (Discriminant Analysis).

Males of the three species are clearly separated on the basis of morphological, acoustic and morphometric (South Wales samples only) characters.

Females from South Wales may be separated by morphometric analysis. Also there is strong evidence to suggest that certain colour morphs of the highly polymorphic females may be species specific.

Sampling sites may be separated into two distinct areas of study (South Wales and South-East England with the Forest of Dean), based on the distribution and host association of the three species.

A preliminary study suggests that a similar differentiation occurs between the western and eastern highlands of Scotland.

On the selection of taxonomic characters by numerical methods

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As a development of the application of numerical methods of classification to the taxonomy of some leafhoppers (Homoptera: Auchenorrhyncha, Cicadellidae), a study was carried out with a view to selecting characters which contribute most to a given classification. Broadly speaking, the aim was to select from a total of n characters (variables) of a data matrix, these p characters with the greatest taxonomic importance and to reject the remaining q variables with very little importance (where $n = p + q$).

Taxonomic importance of characters was inferred through their information content which in turn was based on the use of various measures of information as indicated below. A three-fold procedure was followed: (a) the information measure (see below) was computed for each of the full reference set of characters and used to select a subset of only a few characters with high scores; (b) the chosen character subset was then used to conduct principal coordinate analysis for the representative sample of species of genus *Batracomorphus* (Homoptera: Cicadellidae), each analysis representing a classification of the species sample; (c) the first 3, 5 and 10 principal coordinates obtained with each different subset of characters were used in a rotational fit procedure to compare the resulting classifications with one based on the full reference set of characters. As a control, ten selections of the same number of a few characters only were made at random. They were also submitted to the principal coordinate analysis and the resulting classifications were eventually also compared by the rotational fit method with the classification based on the full reference set of characters.

A well-known measure of information content is the Shannon-Weaver statistic, widely used in ecology as a measure of diversity, but so far with only a few applications in taxonomy. This and other indices of diversity, such as Brillouin and Gyllenberg measures, were also calculated for each of the whole set of characters as defined above.

This preliminary study shows that in the sample of species considered, classifications based on a restricted number of characters with high values of information content in the sense here described are closer to the reference classification than are classifications based on an equal number of characters randomly chosen. These results suggest, therefore, that the use of such statistics may constitute a general method of selection of subsets of characters effectively reproducing the main features of the reference classification based on the full set of characters.

The numerical procedures and other computations were carried out by specially written Fortran programs by one of the authors (RGD) on the CDC 6500 computer at Imperial College, London.

For facilities or financial support Calouste Gulbenkian Foundation in Lisbon, INIC (Ministry of Education in Lisbon) and Imperial College Computer Centre in London are thankfully acknowledged.

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Adaptive radiation in leafhoppers: Erythroneurini on Madeira and the Canary Islands (Homoptera, Auchenorrhyncha, Cicadellidae, Typhlocybinae)

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Cases of adaptive radiation in the form of ample speciation within a presumably monophyletic taxon resulting in a group of species (in the sense of genpools isolated from each other by pre- or post-mating isolating mechanisms), each of which is more or less specialized in using some or only one of the existing «econiches» of an area, seem to have been little studied in Auchenorrhyncha up to now. As apparently islands of oceanic origin at a certain «developmental age» offer the best opportunities for adaptive radiation at species- and species-group-level (due – amongst other factors – to the existence of not-yet-occupied habitats), cases of adaptive radiation might be suspected, where relatively high numbers of species (compared with the numbers on adjacent continents) of a supraspecific taxon are to be found on one single or a group of oceanic islands. Auchenorrhyncha-species-groups on Galapagos Islands (Acanaloniidae: *Philatis* STÅL) and Hawaii (Cixiidae: *Nesoliarus* KIRK., Delphacidae: *Alohini* MUIR, Cicadellidae: *Nesophrosyne* KIRK.) might represent such examples of adaptive radiation (see FENNAH 1967, GIFFARD 1922a, 1925a, ZIMMERMANN 1948). One case so far neglected seems to exist closer to Europe: the Erythroneurini on Madeira and the Canary Islands. Whereas all other Typhlocybid tribes (Alebrini, Empoascini, Dikraneurini and Typhlocybini) are represented by few of the continental genera and a small number of species only on these islands; the Erythroneurini are represented by fewer genera, too (only *Tamaricella* ZV., *Zyginidia* HPT., and two groups of species placed by DWORAKOWSKA 1970, 1971 into *Ciudadrea* DW. and *Asianidia* ZV.), but by a larger number of species than on the adjacent continent: already LINDBERG (1954, 1961) records no less than 22 species (all endemic) of those groups later placed into the two last-mentioned genera. This number seems by far too low: own research has shown to exist at least fifty species of these groups.

The definite number of now existing species – one of the research topics when examining a group like this – cannot be told yet: many of the taxa are morphologically, ecologically and distributionally well characterized, but difficulties arise with "polyphageous" taxa and taxa found on more than one island (geneflow interrupted or not?). By biosystematic research on isolating mechanisms, host-plant-specifity, etc. some progress might be expected.

Evolutive differentiation between the Canaro-Madeiran taxa has taken place not only in colour and markings (in many species apparently cryptic, i. e. adapted to the host-plant's colour, in others very conspicuous – perhaps somatolytic?), but also in the length of head and rostrum (species living on densely long-haired host-plants possess a long head and rostrum), the absolute and relative length of the legs (long-legged species on hairy host-plants), and the structure of the male aedeagus (no adaptive value can be found in this character).

Specialization on host-plants is remarkably high: only three species on the Canary Islands and three on Madeira seem to be more or less polyphageous, the majority of at least 45 species is oligo- or monophageous. All species inhabit the low vegetation (shrubs and dwarf-shrubs), no one has been found to colonize the canopy of the laurel forest, only the few polyphageous species additionally colonize annual weeds. The majority of oligo- or monophageous species is to be found on Labiatae (at least 20 species), followed by Compositae (at least 10 species), Papilionaceae (4), Crassulaceae (4), Cistaceae (4), Urticaceae (2), Salicaceae (1), Borraginaceae (1). Monophageous species occur on endemic as well as on non-endemic plant species. Except *Cistus symphytifolius,* no plant species has more than one specialized Erythroneurini-species in the same locality, but replacement of one species by another one on that plant on a different island is found, as well as the occurrence of a polyphageous species additionally to the monophageous on the same plant. Some plant families (like Cruciferae) are "empty", in general there is no correlation found between the number of plant species of a family present on the islands and the number of specialized Erythroneurini-species. Despite the limited space and resources of an island, concerning reproduction apparently no K-strategists have evolved, all species so far observed are r-strategists sometimes killing their host-plant specimen by mass development.

Most species seem to be distributed on an island with its host-plant(s). Geographic distribution of many species seems to be rather restricted: on Canary Islands at least 15 species are found on a single island only, on the Madeira group only 2 species are found on more than one island.

No correlation exists between species-number and size of the islands: the largest of the Canary Islands, Tenerife, has the highest number of species (about 30), the next in line, Fuerteventura, only one, the smallest, Hierro, at least 10.

Correlation seems to exist between species number and ecological diversity of each island, instead.

Research has been started to find out the relationship between the Canaro-Madeiran Erythroneurini-taxa and of these to continental groups in order to understand by this the historical process of colonisation, ecological and morphological changes.

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A new portable, battery-powered insect suction trap, Intersect 1A

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This vacuum insect net is used for registration, analysis and forecasting of insect populations. It is especially useful for ecological investigations, as well as for the control of pests and beneficial insects within the scope of plant protection projects.

In order to improve the reliability of sampling, it is recommended to enlarge the size and number of spot tests. This requires a technique which ensures reproduceable samples.

Technical information:

The INTERSECT sampling device is powered by a DC axial blower at 12 V, 29 Amps at 2350 RPM. It generates an airflow of 2.400 m^3 per hour at a difference of pressure of 120 pascal and can also be run at half-power.

Power is delivered by a NiCd-storage-battery-belt with a capacity of 4 resp. 7 Ah, which suffices for more than 1000 samples per load at the typical operational duration of 10 sec. The interval is adjustable from 5 to 45 sec, continuous operation is possible.

The ventilator is enclosed in a case of high-tension steel with a collecting head of 30 cm diameter. The collecting nets are interchangeable.

INTERSECT in comparison to the sweep net:

The samples were taken in dry grassland in a fallow-lying vineyard near Tübingen, FRG, in September 1982.

About 40% of the vacuum-trapped animals were Diptera, followed by approx. 14% Hymenoptera and 14% Auchenorrhyncha.

The sweep net shows a different scene - 35% Diptera, followed by approx. 20% spiders and 18% aphids.

The difference is most obvious for Auchenorrhyncha and Hymenoptera, which were more efficiently caught by INTERSECT, and for beetles, bugs, and aphids, better seized with the sweep net.

INTERSECT in comparison to the beating funnel:

We used the beating funnel according to STEINER. The samples were taken from a 6-year old hedgerow in the Lautenbach farmland near Heilbronn, FRG, from May to September 1983.

For statistical evaluation we used the U-test. For Psyllina, Planipennia, Dermaptera, Lepidoptera, and Corrodentia, the samples were too small for the U-test, thus we had to use the sign-test. In most of the cases, a level of confidence of 99% (U-test) or 95% (sign-test) was found.

For collecting Hymenoptera, Auchenorrhyncha, Diptera, Planipennia, and adult Lepidoptera, the suction trap was superior to the funnel. For Coleoptera, Heteroptera, Dermaptera, and Aranea, the yield was better with the beating funnel. For the other groups, no significant difference was found.

Conclusions:

The suction trap is a fast and effective sampling device that attains large samples and allows for accurate probing of insect populations.

Insects are kept inside the net by a stand-by air flow until the sampling bag is replaced. For small insects that do not cling to the vegetation, the INTERSECT is superior to the sweep net and the beating funnel.

Leafhopper endocytobiosis as an intracellular ecosystem[1]

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In special host cells (bacteriocytes), the small leafhopper *Euscelis incisus* (Kbm.) contains two types of essential bacteria-like symbionts (endocytobionts). Within the nucleocytoplasmic system of their host cells, these synthesize anabolites (e. g. amino acids, vitamins) by utilizing the host's catabolites (e. g. urea, uric acid). They thereby probably regulate pH, osmotic pressure, and certain endogenous rhythms of the host cell.

Such functions are generally analogous to those of the DNA-containing cell organelles (mitochondria, plastids). However, eukaryotes and endocytobiotic systems differ in one essential point. An endocytobiosis between self-reproductive endocytobionts is an oligogenetic, intracellular ecosystem. The eucyte, with its semi-autonomous DNA-containing organelles, represents a central regulatory system, which is more highly structured than the most complex ecosystem with its diverse components. The leafhopper endocytobiosis must be classified between these two types of systems.

These correlations are analysed based upon the physiochemical composition (pH, osmotic pressure, inorganic ions, organic molecules) and evolution of host cells, endocytobionts, and nutritional substrates. The data and conclusions represent a contribution to the verification or falsification of the endocytobiotic cell theory. They also assist in establishing a new synthetic research area between symbiosis research and cell biology: "endocytobiology".

[1] H. E. A. Schenk & W. Schwemmler (eds.). 1983. *Endocytobiology II. Intracellular space as oligogenetic ecosystem*. Walter De Gruyter, Berlin/New York

Fine structural analysis of leafhopper egg cell[1]

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Mature egg cells of the small leafhopper *Euscelidius variegatus* (KBM.) were analysed with the help of composite electron micrographs of longitudinal and cross sections. To the best of our knowledge, these are the first investigations carried out on such a large, centrolecithal egg of the telotrophic, meroistic ovariole type, which is extremely poor in plasm. The egg architecture is described with emphasis on the qualitative and quantitative distribution of the egg structures studied. There are four significantly different regions in the leafhopper egg according to the distribution of ribosomes, vacuoles, endoplasmic reticulum, mitochondria, microbody-like structures and reserve substances. These regions are the periplasmic anterior pole, periplasmic posterior pole, other periplasm and the central region. The posterior pole region is of particular importance and differs from the anterior pole region in that it contains the symbiotic ball and a greater number of glycogen-ooplasm-complexes.

The ribosome-rich, granulated glycogen-ooplasm-complexes are considered to be a special form of fermenting ooplasm. These complexes are spread out over a small area and increase in frequency in the direction of the posterior pole. They are possibly identical with the fermentative gradient which was postulated in an earlier working hypothesis. Microbody-like structures which are specific to the egg are discussed as possible organelles for the degradation of various reserve substances, i. e. lipids, protein and glycogen.

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New concepts in the taxonomy of Afrotropical Pentastirini

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Since the second half of the past century about 170 Cixiidae were described from the African continent south of the Sahara, in thirteen genera. About 100 taxa were referred to the composite genus *Oliarus* STÅL. A taxonomic revision of the genus was undertaken, giving a redescription of all the species, based primarily on the structure of the male and female genitalia.

The tribe Pentastirini was erected by EMELJANOV (1971) to accomodate eight genera with, except for the genus *Oliarus,* a predominantly Palearctic distribution. The following diagnostic characters were used: mesonotum with five carinae (i), ovipositor reduced (ii), valvulae 1 not corrugated (iii) and valvulae 2 not fused together (iv). The selection of these characters was based mainly on a study of the Palearctic fauna, and some of these are not applicable to tropical Pentastirini.

The question whether the African *Oliarus*-species are congeneric with the type-species of the genus, namely *Cixius walkeri* STÅL, cannot be solved with a geographically limited study; a more detailed revision of the Oriental fauna will be needed to elucidate this problem. Nevertheless, the genus *Oliarus,* as it is defined in the present literature, is polyphyletic. We were able to recognise nine new genera among the African species; the Palearctic genera *Pseudoliarus* HAUPT and *Pentastiridius* KIRSCHBAUM were recognised as well. For scientific reasons, new names cannot be used in this paper and we will confine ourselfs to a brief discussion of the characters used.

Characters of the head such as the proportions of the vertex and face, the structure of the subapical keels on the vertex, the presence or absence of maculae (round, oval) and fenestrae (see FENNAH, 1958), and to a lesser extent color, are useful to distinguish species-groups. Sometimes the postclypeus is swollen and enlarged at the expense of the frons. In this case the median carina and the median ocellus are reduced or even totally absent. In some species-groups the characters mentioned above are useful as a diagnostic character, in others to a lesser extent by the presence of intermediates, which makes them less applicable in keys.

Most *Oliarus*-species bear five longitudinal carinae on the mesonotum; some southern African species however have only three keels, the two submedian ones being reduced or totally absent. This feature, which is most frequently used for the recognition of Pentastirini, thus has to be treated with caution.

The wings and especially the tegmina bear some characteristics which are constant at the specific level but which can vary considerably within species groups. Granulation of the veins - granules regularly spread along the costal margin or confined to the proximal fourth or fifth - is constant within a species but difficult to describe. The tegmina can either be fully developed or reduced. In two species from the Cape Province (South-Africa) the second pair of wings is lacking.

The chaetotaxy of the hind tarsi has proved to be a very good diagnostic character. Some genera, like *Pentastiridius,* bear a double row of apical teeth, variable in number within a species, and described by FENNAH (1958) as "scale like teeth". The greater part of the species bear one apical row of a constant number of black teeth along the first and second segment of the hind-tarsi, f. i. seven (first tarsite) and five (second) in the genus *Pseudoliarus* or *Cixius walkeri,* or seven/seven in f. i. *Oliarus runingensis* SYNAVE. Aberrations however on one leg of a specimen may occur and its usefulness in a cladistic analysis is limited because it probably evolved several times during the course of evolution.

The male and female genitalia provide the most useful characters in the taxonomy and phylogeny of Afrotropical Pentastirini. The external parts of the male genitalia, more particularly the anal segment, the pygofer and the genital styles enclose the aedeagus. The latter consists of a sclerotised basal part, the periandrium, and an articulating, mostly membraneous part, usually called the flagellum. The aedeagus is connected to both sides of the pygofer by means of the left and right tip of the basal part of the periandrium. This condition is present in all Afrotropical Pentastirini and it may serve as a good synapomorfic character for the tribe. Some more species of other realms have to be examined to affirm this statement. The character was not used by EMELJANOV in his definition of the tribe, but it was present in all palearctic species examined by the author.

The (unmovable) spines on the periandrium, as well as the (movable) spines on the flagellum, their proportions and implantation proved to be the most reliable features for species recognition. The shape of the pygofer, anal segment und genital styles proved to be very helpful as well, but different species sometimes share the same kind of processes (convergence?). Although the form of the aedeagus can differ strongly from species to species, lock-key mechanisms could never be proved with parallel differences in the female genitalia, as described for *Cixius* species from the Azores by Remane & Asche (1979).

Finally, the external female genitalia also bear good taxonomic characters. Differences were found in the shape of the anal segment, the form and the length of the valvulae, and the shape of the pregenital sternite. These results enable us to provide a better redescription of species which are only known from female material. Nevertheless, only in a few cases female genitalia could be used for the purpose of species identification, but it showed to be a very reliable character for the recognition of species groups and genera.

Emeljanov, A. F. 1971. *New genera of leafhoppers of the families Cixiidae and Issidae (Homoptera, Auchenorrhyncha) in the USSR*. Ent. Review, Wash. *50:* 350-354.

Fennah, R. G. 1958. *Fulgoroidea of South-Eastern Polynesia.* Trans. Roy. Ent. Soc. London *110* (6): 117-220.

Remane, R. & Asche, M. 1979. *Evolution und Speziation der Gattung Cixius* Latreille 1804 *(Homoptera Auchenorrhyncha Fulgoromorpha, Cixiidae) auf den Azorischen Inseln.* Marb. Ent. Publ. *1* (2): 1-264.

"Wax area" in cicadellids and its connection with brochosomes from Malpighian tubules[1]

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Our unpublished data on origin, structure and function of the so-called "wax area" of Cicadellids have been accumulated since 1956. Basic orientation points for our investigations were papers of several authors, who worked on *Cicadulina mbila* (Naudé) (Storey, H. H. & Nichols, R. F. W. 1937. Proc. R. ent. Soc. Lond. *12:* 149-150), heterogeneous insect species but chiefly leafhoppers (Tulloch, G. S. *et al.* 1952. Bull. Brooklyn ent. Soc. *47:* 41-42; Tulloch, G. S. & Shapiro, J. E. 1953. Bull. Brooklyn ent. Soc. *48:* 57-63; Tulloch, G. S. 1954. Science *120:* 232; Wilde, W. H. A. & Cochrane, G. W. 1957. Proc. ent. Soc. Br. Colomb. *53:* 19), *Orosius argentatus* (Evans), *Cicadulina bimaculata* Evans, *Austroagallia torrida* Evans, *Eurymeloides* sp. (Day, M. F. & Briggs, M. 1958. J. Ultrastruct. Res. *2:* 239-244), and *Macrosteles fascifrons* Stål (Smith, D. S. & Littau, V. C. 1960. J. biophys. biochem. Cytol. *8:* 103-133). Later, papers concerning brochosomes were selectively reviewed and synthetized (Wigglesworth, V. B. 1972. The principles of Insect Physiology. London, Chapman & Hall, 7th ed.).

According to the results of our researches, we are induced to specify that:

- "wax area" or "aire cireuse", well known for Typhlocybins (Ribaut, H. 1936.

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Faune Fr. *31*) and believed originated from a secretion of a wax area gland (OSSIANNILSSON, F. 1978. Fauna ent. scand. *7*, 1), is due to accumulation or storing of brochosomes (Gr. βρόχοσ = mesh of a net, σῶμα = body) produced by Malpighian tubules cells;

- brochosomes, also named "Kügelchen" or "spherules" (GÜNTHART, H. 1977. Mitt. Schweiz. Ent. Ges. *50:* 189–201; GÜNTHART, H. & GÜNTHART, M. 1983. Mitt. Schweiz. Ent. Ges. *56:* 33–44), flow from the anus within droplets which are collected by the tibiae of the hind legs and transferred on the fore wing "wax area" or spread on the body surface;
- the medial side of the hind tibiae is provided with a comb of setae used both to store the droplets on the fore wings and to distribute brochosomes over great part of the body;
- the medio-ventral part of the fore tibiae is also provided with a comb of setae that is used to distribute brochosomes on the anterior part of the body;
- the "wax area" is more or less well differentiated in almost all Typhlocybinae;
- brochosomes are present in almost all Cicadellidae, adults and nymphs;
- brochosomes were not found only on Ledrinae and Ulopinae.

Our further investigations on several aspects of brochosomes are progressing.

Acoustic isolation in the genus Javesella?

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Reproductive isolation of different species belonging to the delphacid genus *Javesella* is amply substantiated for Dutch populations by their differentiation in hostplant relations and acoustic behaviour, as well as by their inability to produce fertile hybrids in experimental crossings (DE VRIJER, P. W. F., 1981. Acta Entomol. Fennica *38:* 50–51). Since "calling-signals" are thought to be primarily responsible for the initial recognition of suitable mating partners, these signals potentially might form the basis for an acoustic isolation mechanism between different species.

In an experimental study on species recognition in *J. pellucida* (FAB.) (DE VRIJER, P. W. F., Neth. J. Zool.: in press) it was found that temperature-induced variation in male calling-signals did not seriously reduce the responsivity of females in play-back experiments, in spite of the drastic effects temperature was shown to have on certain parameters of the male calling-signal, such as strophe duration and pulse repetition rate. It was concluded that such parameters apparently are not of primary relevance to species recognition and that their differentiation therefore may not be expected to effectively ensure acoustic isolation between closely related species.

At present it is not known for any planthopper species which features of the acoustic signals actually serve as cues for species recognition, nor how different these should be from those of other species to lead to acoustic isolation. Therefore, conclusions on the function of acoustic signals in reproductive isolation of closely related species require further experimental analysis, e.g. by means of play-back experiments. Table 1 presents some preliminary results of such experiments, which elsewhere will be reported on in more detail. At this stage it cannot be decided whether these results, which remarkably differ not only between different pairs of species but also between reciprocal combinations of the same pair of species, may be considered to reflect the actual significance of calling-signals in species isolation. Finally it should be emphasized that calling behaviour represents only the initial stage of mating behaviour in planthoppers and that more definite conclusions on possible acoustic isolation mechanisms require a complete analysis of courtship and mating behaviour.

Table 1: Mean levels of responsivity shown by females to play-back of male calling-signals of different species at 20 °C. (For details on methodology see DE VRIJER, P. W. F., Neth. J. Zool.: in press)

Female species (n = 20)	Male species J. dubia	J. obscurella	J. pellucida
J. dubia (KBM)	96%	8%	18%
J. obscurella (BOH.)	22%	99%	44%
J. pellucida (FAB.)	30%	10%	98%

Flight in grassland and arboreal Auchenorrhyncha

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Except in some major pest species, flight in Auchenorrhyncha has been insufficiently studied. Simple tests, e.g. releasing individuals from a height of 5.5 m, indicated that some species are primarily "flyers", others "flitters" or "jumpers". A comparative study of the flight apparatus should be rewarding.

Flight ability was also guaged by catches in a series of aerial suction traps, in which a third of all the species of British Auchenorrhyncha were recorded. For 10 years two identical traps were operated side by side at 1.2 and 9.1 m above ground level. More individuals of the arboreal species were caught in the higher trap, while the reverse was true of dwellers on low vegetation. Probably it is not migratory, but trivial flight that leads to this aerial stratification of species.

Alary polymorphism is common in Auchenorrhyncha, but in many taxa of the Hemiptera it is absent in the arboreal species. Thus all tree-dwelling cicadellids are fully winged and so are all Psyllidae and Aleyrodiade among the Sternorrhyncha and most of them live on woody Angiosperms. Again, most phytophagous, arboreal Heteroptera are macropterous and monomorphic (Table 1). Retention of wings by tree-dwellers may be related to the architectural complexity of trees and the wider spacing of their leaves and branches than in habitats of low vegetation. In complex and essentially three-dimensional arboreal habitats ability to fly may be more advantageous than the "option of brachyptery" with its possible increase in fecundity.

Tab. 1: Absence of wing polymorphism in some taxa of phytophagous, arboreal, British Hemiptera.

	Trees & Bushes		Low Vegetation	
	n, spp.	- n, polymorphic	n, spp.	- n, polymorphic
HOMOPTERA				
Cicadellidae	104	0	164	26
Delphacidae	0	-	70	68
Psyllidae, Aleyrodidae	All fully-winged, most on woody Angiosperms			
HETEROPTERA (Excluding Cimicidae and shore and water-bugs	111	11*	240	75

* 9 spp predacious; 1 sp under bark

Typhlocybine damage to sycamore trees

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The visible "stippling" caused by mesophyll feeding typhlocybines on the leaves of many tree species is very extensive, but there have been few attempts to measure it and its effect on the tree. We measured the leaf area damaged by a moderate infestation of *Ossiannilssonola callosa* (Then) on sycamore *(Acer pseudoplatanus)* in a mixed deciduous woodland in North Lancashire, England, and compared the effects of damage on infested trees with that on similar trees which were virtually free of typhlocybines because they were foraged by the ant *Formica rufa*. Ant-foraging on some trees was experimentally reduced by placing grease bands on the trunks (Skinner & Whittaker 1981).

O. callosa were counted on the leaves at three heights in the canopy with access from scaffold towers 8 m high. Areas of dead mesophyll cells were assessed by placing a transparent grid over the leaf surface (Whittaker 1984).

Populations of Typhlocybinae

Following low numbers of *Empoasca vitis* (Göthe) observed in April, *Ossiannilssonola callosa* nymphs appeared in late May and the first adults by the end of June (Fig. 1). These declined in numbers by the end of July and a second generation occurred in August and September. The first generation tended to be more abundant in the upper than the lower canopy in 1982 but the reverse was true of the second generation. This distribution pattern was not repeated in 1983.

In both years, ant foraged trees had significantly fewer *O. callosa* nymphs and adults than had unforaged trees. Banded trees were intermediate.

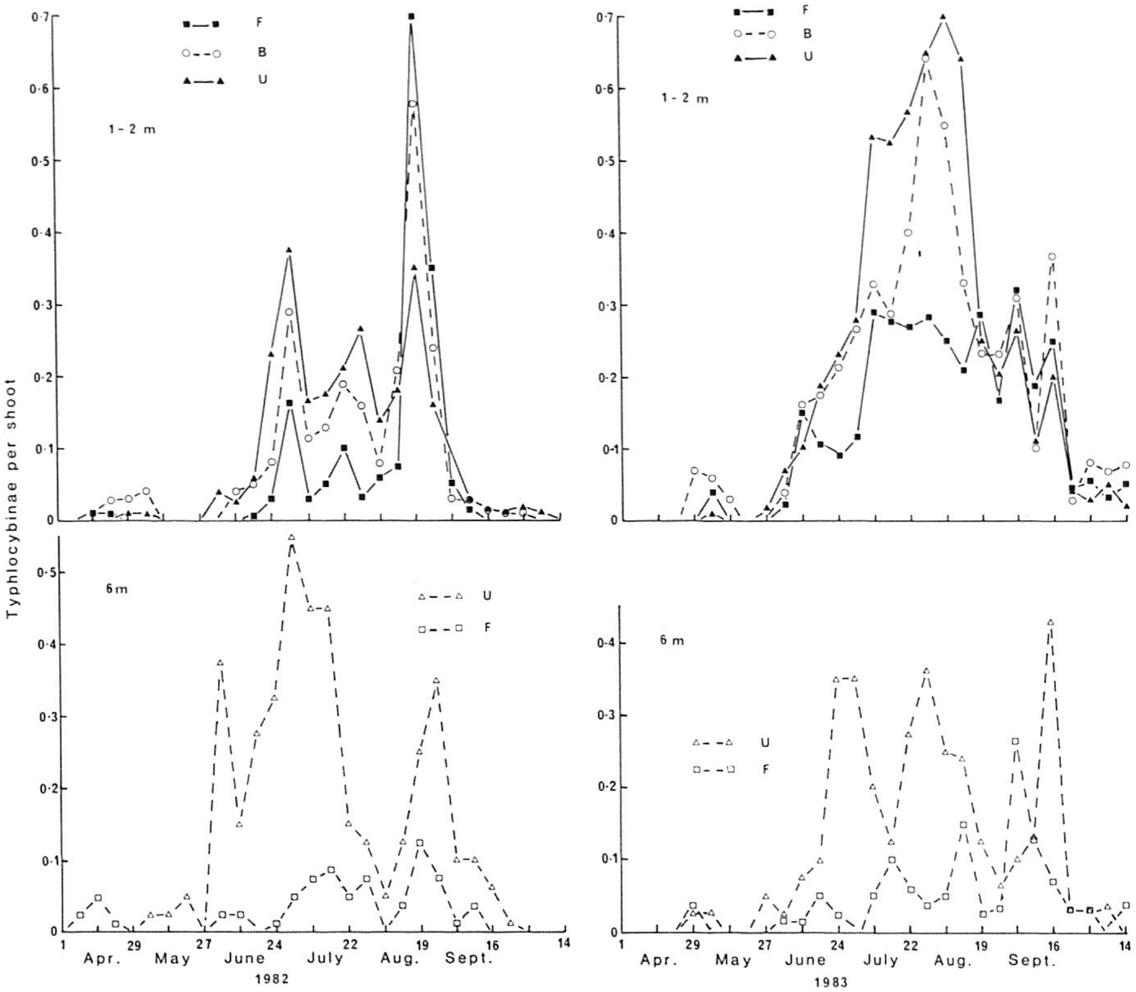

Fig. 1: Numbers of typhlocybinae per shoot of sycamore at 1-2 m and 6 m hight in Cringlebarrow wood in 1982 and 1983. F = foraged by ants; U = unforaged; B = banded trees.

Accumulated damage in September

In 1982, damage in the lower canopy (1-2 m) of unforaged trees was 2.8 ±0.3% of total leaf area whilst at 6 m it was 1.5 ±0.2% and at 9 m it was 2.1 ±0.2%. In 1983 overall damage was slightly greater but was again concentrated in the lower part of the canopy (3.6%) compared to the upper (1.8% of total leaf area). Ant foraging reduced the damage to 0.3 ±0.1% at all three levels in 1982 and to 0.6 at 2 m and 1.0% at 6 m in 1983.

The visible damage by typhlocybines to sycamore leaves has two consequences (WHITTAKER 1984). Firstly it reduces photosynthesis approximately in proportion to the amount of visible damage and secondly the entry punctures of the stylets on the abaxial leaf surface result in increased water conductance from the leaves. Three to four percent damage is a significant contributory factor, along with sap removal by aphids and leaf area removal by Lepidoptera larvae, causing a reduction of radial timber growth of approximately 30% in trees which were unprotected by predatory ants compared with trees to which ants had access.

SKINNER, G. J. & WHITTAKER, J. B. 1981. *An experimental investigation of inter-relationships between the wood-ant (Formica rufa) and some tree-canopy herbivores.* Journal of Animal Ecology *50:* 313-326.

WHITTAKER, J. B. 1984. *Responses of sycamore (Acer pseudoplatanus) leaves to damage by a typhlocybine leaf hopper, Ossiannilssonola callosa.* Journal of Ecology *72:* 455-462.

Revision of the family Meenoplidae (Fulgoroidea): problems and progress

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Of the twenty families of the Fulgoroidea currently recognised, the Meenoplidae is one of the smallest, with around 100 described species. The family is confined to the Old World and most species are found in the tropical and subtropical regions.

Some preliminary information on the geographical variation in male genitalia in the most common and widespread species *Nisia nervosa* (Motsch.) was given at the previous (4th) Auchenorrhyncha workshop in Finland (Wilson, 1981). It was intended that the analysis of geographical variation would be carried out in conjunction with a revision of the family.

There are considerable advantages in studying an "entire" family, especially from the phylogenetic and zoogeographic standpoint. As far as fulgoroid families are concerned the Meenoplidae is well defined, recognised by the distinctly "granulate" claval veins of the forewing coupled with a long final segment to the rostrum among other characters. The term "granulate" for the appearance of the claval veins is actually misleading, SEM study has shown that the granulations are in fact sensilla. Similar sensilla are present on the inside margins of the prominent lateral carinae of the face.

From a practical standpoint also, the current small size of the family with only 106 species in 9 genera make it a good one to attempt to monograph over a reasonably short time. However, it is not without its taxonomic problems. Muir (1927) stated that Dr. E. Bergroth was revising the family at the time of his death, and went on to say "... the few genera placed in this family are closely allied and the species mostly inadequately described". The situation has hardly improved since 1927. Over twice as many species are now known compared with 1927, but no new genera have been described and few "older" species have been adequately redescribed. It has proved difficult to assign many apparently undescribed species to present genera and in addition it now appears that some generic synonomy is necessary (even with only 9 genera!). Some of the larger existing genera consist of a number of species groups which represent good new genera. As with almost all groupe under revision, study reveals there to be large numbers of undescribed species. In the case of Meenoplidae a detailed study of African specimens shows at least a 50% increase in species. A similar number of undescribed species is expected from the Oriental and Pacific faunas.

Due to the taxonomic problems in the group I consider it ill advised to describe further new species until a thorough assessment of generic concepts in the family has been carried out. This reassessment, together with the redescription of some previously described species is now being carried out and I hope will be able to be completed in a fairly short time.

Muir, F. 1927. *New species of African Meenoplidae (Fulgoroidea, Homoptera).* Ann. Mag. Nat. Hist., Ser. 9, vol. XIX, 197–208.

Wilson, M. R. 1981. *Geographical variation in Nisia nervosa* (Motsch.) *(Fulgoroidea, Meenoplidae): A preliminary note.* Acta Entomol. Fenn. *38:* 53.

Descriptions of the immature stages and biology of Peregrinus maidis (Ashmead) (Homoptera: Delphacidae)

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Peregrinus maidis (ASHMEAD) is a pantropical delphacid that has been implicated as an important vector of viral diseases of maize *(Zea mays* L.) in the lowland humid tropics (METCALF, Z. 1943. Gen. Cat. Hemiptera, Fasc. IV, Pt. 3; BREWBAKER, J. 1979. Econ. Bot. *33:* 101–118). *P. maidis* adults and immatures were reared on potted maize in an environmental chamber at 12L : 12D, and either 10°, 15.6°, 21.1°, 26.7°, or 32.2 °C, in order to obtain eggs and nymphs for descriptions and to determine the effects of temperature on development.

The major features useful for separating the five nymphal instars include the numbers of metatarsomeres (instars I–III with 2; IV with 2, one of which is partially subdivided; V with 3), antennal sensoria (I-0, II-2, III-4, IV-6, V-9), pits between each lateral frontal carina and compound eye (I-2, II-3, III to V-4), and pronotal pits (I to III-12; IV, V-14), and the shape, size and spination of the metatibial spur (longer and flatter as development progresses with the following number of small teeth: I-1, II-1, III-5, IV-10 to 12, V-16 to 20).

Rearing at 10° and 32.2 °C resulted in cessation of development and death by instar IV. Rearing at 15.6 °C resulted in a supernumerary instar VI. At 21.1° and 26.7 °C, development proceeded normally with shorter stadia at the higher temperature (Table 1).

In the United States, *P. maidis* is only found regularly in southern Florida. Our results indicate that the northward distribution of *P. maidis* into major maize producing areas is probably prevented due to its lack of complete development at

Tab. 1: Development (X ± SD in days) of *P. maidis* at various temperatures. N = number of nymphs beginning each stage.

	TEMPERATURE (°C)				
INSTAR	10	15.6	21.1	26.7	32.2
I	10.0 ± 6.3 N = 44	7.7 ± 2.8 N = 71	5.2 ± 1.5 N = 49	4.3 ± 1.5 N = 89	1.9 ± 1.1 N = 67
II	20.2 ± 10.0 N = 18	11.1 ± 2.8 N = 41	4.6 ± 1.6 N = 42	3.1 ± 1.4 N = 53	4.2 ± 1.5 N = 58
III	24.3 ± 10.2 N = 4	10.5 ± 4.1 N = 25	5.4 ± 2.3 N = 33	3.3 ± 1.6 N = 39	10.6 ± 5.8 N = 33
IV	10.0 ± 22.6 N = 2	13.5 ± 4.9 N = 17	6.0 ± 2.7 N = 26	3.3 ± 1.3 N = 35	16.8 ± 6.4 N = 6
V	-	12.7 ± 6.0 N = 15	6.0 ± 0.8 N = 15	4.4 ± 1.2 N = 17	-
VI	-	9.7 ± 4.0 N = 3	-	-	-

10 °C and apparent absence of an overwintering stage. Its lack of complete development and short adult longevity (Tsai & Wilson, unpubl. data) at 32.2 °C correlates with the low incidence of maize viruses in southern Florida in summer (Tsai, pers. obs.).

Diversity and seasonality of Panamanian cicadas

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Panama has a rich fauna of cicadas. In light-traps in 6 localities a total of 30 species was obtained. Prof. J. A. Ramos kindly identified these species for me. There were no significant differences between sites in diversity but there were large differences in species composition.

Cicadas in Panama tend to be much more seasonal in their presence as adults than most other insects. With one possible exception none of the species occur around the year. Some are present as adults in the early dry season, some in the late dry season, others in the early or middle rainy season. In Fortuna, a mountain area with no dry season but with heavy rains throughout the year, the 4 species sufficiently common for analysis are fairly seasonal and occur from late April through October, with a peak around May/June. Virtually no cicadas were collected here between November and March. The curious exception referred to above is *Selymbria stigmatica* (Germar), a species which I have found only on Barro Colorado Island (BCI). This species is either seasonally bimodal and dichromatic, or consists of two closely related species. For some of the species which were studied in more than one site, there are interesting differences in seasonality between these sites.

The proximate factors affecting the seasonal distribution seem to be easy to determine. A first glance at the seasonal distributions suggests that the major determining factors have to do with the onset and end of the rainy season. Many species appear in large numbers just after the beginning of the rains, others after they end. *Quesada gigas* (Olivier) appears in February when the soil usually really begins to dry up. However, observations over a number of years show that variation in timing of the season of each species is only partly related to the actual seasonality of the rains that year. *Quesada gigas* starts singing in mid-February whether the rains stopt early November or went on until the end of January. The first individuals of the early rainy season cicadas emerge weeks before the rains come. It seems that natural selection has timed the adult season of the cicadas in relation to the alternation of wet and dry seasons, but that the synchronising factor is something other than the rain or dryness. Possibly daylength has an effect through the plants on the roots of which the nymphs are feeding.