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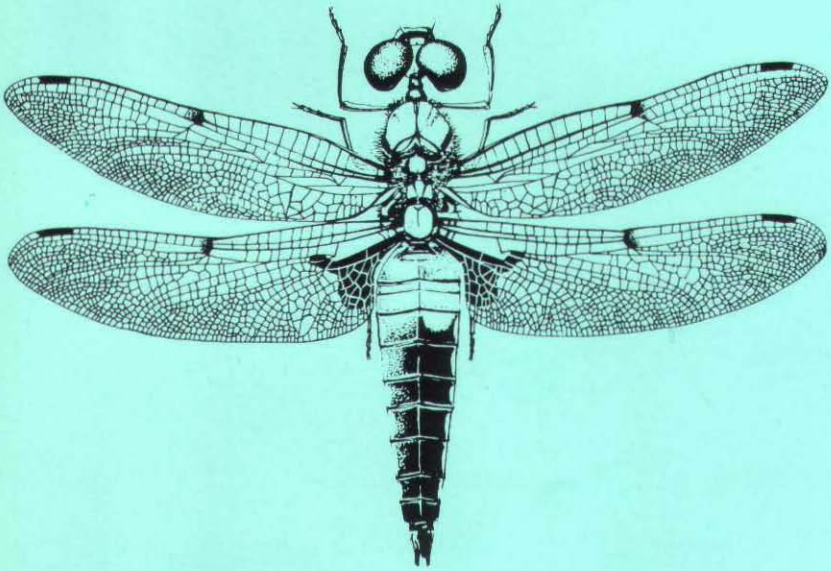

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affiliated to the Societas Internationalis Odonatologica

The *Journal of the British Dragonfly Society*, normally published twice a year, contains articles on Odonata that have been recorded from the United Kingdom. The aims of the British Dragonfly Society (B.D.S.) are to promote and encourage the study and conservation of Odonata and their natural habitats, especially in the United Kingdom. The B.D.S. is affiliated to the Societas Internationalis Odonatologica (S.I.O.).

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Front cover illustration of *Libellula quadrimaculata* by David Miller.

British dragonflies in the latter part of the age of dinosaurs

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Some 146 million years ago, the Jurassic sea, which had covered much of what is now the British Isles, retreated from southern England. There then followed an approximately 27 million year interval, continuing into the Lower Cretaceous, during which time a variety of non-marine environments was established. The newly emergent land was colonised by various terrestrial and freshwater organisms including dinosaurs and insects, the latter including dragonflies and damselflies. A kilometre thick pile of sedimentary rocks accumulated, traditionally known as the Purbeck and Wealden beds (Table 1) after their typical outcrop areas. These strata have yielded the fossilised remains of Odonata belonging to at least 13 species (Table 2). The insect remains occur in limestone beds (Lulworth and Durlston Formations) or in ironstone or fine sandstone lenses (Weald Clay). Fossils tend to be oxidised in the Lulworth Formation but colour pattern is often preserved in younger strata (Fig. 7). Odonata are usually represented by detached wings and body parts of adults; immature stages are as yet unknown. Where did they live? Sedimentary studies indicate that one important land area, Londinia, lay to the north occupying much of what is now

Table 1. British Upper Jurassic — Lower Cretaceous insect-bearing rocks

Lower Cretaceous	Weald Clay	125
	Wadhurst Clay	
	Ashdown Beds	
	Durlston Formation	144
Upper Jurassic	Lulworth Formation	
	Ampthill Clay	160

Note 1. The numbers indicate approximate absolute ages in millions of years Before Present based on Harland *et al.* (1982).

2. The Wealden Series (Wealden Beds of authors) comprise the Durlston Formation — Weald Clay inclusively (Allen, 1976).

3. The Lulworth and Durlston Formations are equivalent to the Lower, Middle and Upper Purbeck Beds of earlier authors (Townson, 1975).

Table 2. Checklist of British Upper Jurassic — Lower Cretaceous Odonata

Suborder Zygoptera

Family Coenagrionidae

1) New genus and species. Jarzembowski, 1984; 1987b. Weald Clay, Capel, Surrey.

'Suborder Anisozygoptera' (of authors)

Family Tarsophlebiidae

2) ?*Tarsophlebia* sp. Jarzembowski, 1987b.
Weald Clay, Capel, Surrey; Durlston Formation, Durlston Bay, Dorset.

3) *Tarsophlebiopsis mayi* Tillyard, 1923.
Ampthill Clay, derived from Boulder Clay, Hertfordshire.

Family Euthemistidae

4) *Euthemis* sp. Jarzembowski, 1987b.
Weald Clay, Capel, Surrey.

Suborder Anisoptera

Family Aeschnidiidae

5) *Aeschnidium antiquum* (Brodie, 1845) Handlirsch, 1906.
(Lulworth Formation, Dinton), Wiltshire.

6) *Aeschnidium bubas* Westwood, 1854.
Lulworth Formation, Durlston Bay, Dorset.

'Family Gomphidae' (of authors)

7) *Aeschnopsis perampla* (Brodie, 1845) Handlirsch, 1939.
Lulworth Formation, Teffont (Evias), Wiltshire.

8) *Cymatophlebiopsis pseudobubas* Handlirsch, 1939.
Lulworth Formation, Durlston Bay, Dorset.

9) ?*Mesogomphus jurassicus* (Giebel, 1856) Handlirsch, 1906.
Lulworth Formation, Vale of Wardour, Wiltshire.

10) ?*Mesogomphus petrifactus* (Hagen, 1850) Handlirsch, 1906.
Lulworth Formation, Vale of Wardour, Wiltshire.

'Family Petaluridae' (of authors)

11) ?*Cymatophlebia agrias* (Westwood, 1854) Handlirsch, 1906.
Lulworth Formation, Durlston Bay, Dorset.

Family Aeshnidae

12) New genus and species. Jarzembowski, 1987a; in press.
Weald Clay, Capel, Surrey.

Superfamily Libelluloidea

13) New taxon. Jarzembowski, 1987b.
Weald Clay, Capel, Surrey.

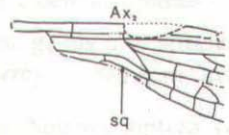
Anisoptera: family uncertain

14) *Agrionidium aetna* Westwood, 1854.
Lulworth Formation, Durlston Bay, Dorset.

Note. The geological occurences for nineteenth century material are taken from original descriptions or Woodward (1895).

London and the Thames valley; another, Corbubia, lay to the west in Devon and Cornwall (Allen, 1981). The climate was subtropical/warm temperate, somewhat arid at first but humid later (Sladen & Batten, 1984; Allen 1976). It is perhaps not too difficult to imagine the decayed remains of flying insects occasionally accompanying the sediment washed down into Wessex and the Weald. An exception to this picture is Table 2: no. 3, the unique specimen of which is embedded in the body chamber of an ammonite and found its way out to the Upper Jurassic sea.

British Odonata in the latter part of the age of dinosaurs were surprisingly diverse. No living species or genera are recognised although some extant families are represented. Zygoptera (damselflies) include the earliest member of the Coenagrionidae which differs from extant species in one important respect: the quadrilateral was still unclosed proximally (Fig. 1). Anisoptera (dragonflies) included Aeshnidae and an especially well preserved gomphaeschnine male has been found recently in the Weald Clay (Figs 6, 7). Gomphaeschninae are no longer found in Britain. Hennig (1981) doubted that extant families of Anisoptera occurred in the Mesozoic era or age of dinosaurs. However, recent finds show not only that they did



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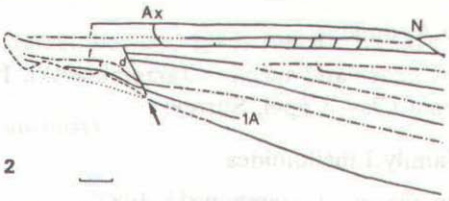

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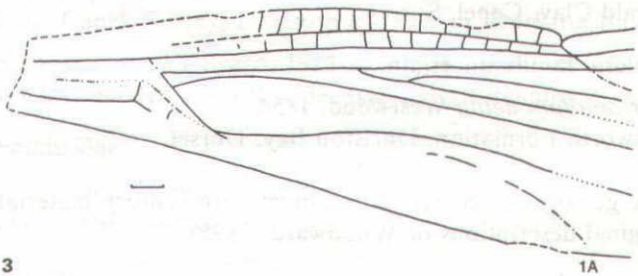

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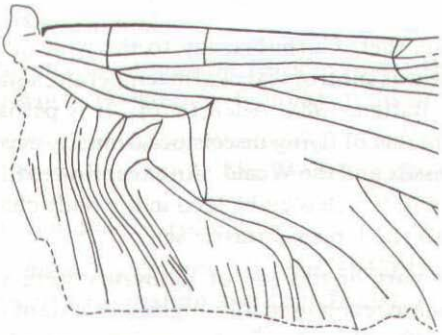

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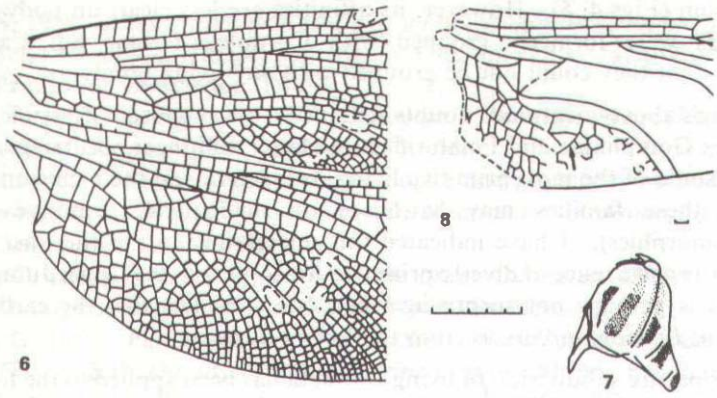

Figs 1-6, 8 proximal halves of wings of:

1 Coenagrionidae new genus and species, Weald Clay.
2 *Euthemis* sp., Weald Clay.
3 *?Tarsophlebia* sp., Weald Clay.
4 Aeschnidiid hindwing, Durlston Formation, Durlston Bay.
5 Crossveins in triangle of Fig. 4.
6 Aeshnidae : Gomphaeschninae new genus and species, Weald Clay.
8 Libelluloid new taxon, Weald Clay.

Fig. 7 Thorax of Aeshidae : Gomphaeschninae new genus & species, Weald Clay.

Note (i) scale line = 1mm except Figs 6, 7 where scale line = 5mm;
(ii) ahhreviations conventional except Fig. 2, d discoidal cell:
(iii) much of crossvenation omitted in Figs. 2-4 and 8 for simplicity;
(iv) drawing conventions after Jarzembowski (1980);
(v) Figs. 1-5, 8 after Jarzembowski (1987b); 6, 7 after Jarzembowski (in press)

occur, but that Libelluloidea, considered by Fraser (1957) to be the most advanced anisopteran superfamily, was also represented. Elsewhere, I have figured the forewing of an early Cretaceous libelluloid from Spain (Whalley & Jarzembowski, 1985: Fig. 9) and a hindwing has since been found in the Weald Clay showing the characteristic elongate anal loop of these dragonflies (Fig. 8, arrow). A distinctive Upper Jurassic-Cretaceous family is the Aeschnidiidae with a libelluloid-like triangle and dense

crossvenation (Figs 4, 5). However, its affinities are less clear; on body characters aeschnidiids were formerly grouped with Cordulegasteridae but Carle (1982) considered that they could not be grouped with any living family.

Hennig's above-mentioned doubts stemmed from supposed Mesozoic records of the families Gomphidae and Petaluridae (the latter no longer occurring in Europe). These are some of the most primitive living Anisoptera and the inclusion of ancient fossils in these families may be based on inadequate, primitive characters (symplesiomorphies). I have indicated this uncertainty in the checklist (Table 2). However, the occurrence of diverse primitive Anisoptera in the Upper Jurassic-Lower Cretaceous is perhaps not surprising when one considers that the earliest known anisopteran, *Liassogomphus*, is from the Lower Jurassic.

The tripartite subdivision of living Odonata has been applied to the fossil record and a number of extinct Mesozoic families have been referred to the Anisozygoptera, today represented only by two Asian species in the genus *Epiophlebia* (Asahina, 1954). The fossil forms usually have a distinct venation, lacking both triangle and quadrilateral and are represented in Britain in the period under consideration by two families, Tarsophlebiidae and Euthemistidae (Figs 2, 3). The occurrence of Anisozygoptera in the Mesozoic is open to doubt and Carle (1982) has suggested that tarsophlebiids, at least, belong to his 'zygopteroid group'. The precise generic affinities of one of our Tarsophlebiidae remain to be elucidated, but our sole euthemistid is readily distinguished by a line of crossveins from R to the posterior wing margin (Fig. 2, arrow).

There has been a revival of interest in British palaeoentomology in recent years, building on the pioneer discoveries of Victorian naturalists and paralleling a growing interest in living dragonflies. Current work, including new fieldwork and interpretation, suggests that the checklist in Table 2 will soon be amended.

Acknowledgements

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Is *Gomphus vulgatissimus* (L.) exclusively a riverine species in the British Isles?

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Gomphus vulgatissimus is well-known in the British Isles as a local inhabitant of moderate to slow flowing, depositional river systems and, to date, all records that confirm breeding support this view. However, elsewhere in Europe it is not unusual to find this species breeding in lakes and ponds, in addition to riverine habitats, over much of its range.
Romande (Dufour, 1978), *G. vulgatissimus* was found to be more frequent on large lakes than rivers.

The reason that has prompted this short note stems from a visit made during the first week of June, 1985, to one of the smaller Shropshire Meres (Berrington Pool). At this site, over several years, I have seen numerous individuals of *G. vulgatissimus* including a number of *in cop.* pairs. However on this one occasion, within a foot of the water's edge, I found a very teneral male, which, judging from its appearance, had only recently emerged. Unfortunately, despite a careful search, no exuvia was found.

Berrington Pool is situated almost exactly one mile from the River Severn (from which it probably derives its *Gomphus* population) but, because of the exceedingly soft integument and limp wings, I am certain this single male could not have flown in from the river.

Interestingly, whilst in France, I visited a chain of recently created fishing pools, surrounded by woodland, close to the River Meuse in the Ardenne. At each of the six pools, exuviae of *G. vulgatissimus* were found in abundance (despite the pools being heavily stocked with fish). The bottom substrate was mainly composed of coarse gravel with only localised deposits of silt interstitially. However, in suitable situations, very narrow fringes of deeper silt were present in the marginal shallows. During a previous visit to this site in 1986 and again this year mating and oviposition were witnessed.

Although positive breeding was not confirmed at Berrington pool and a shortage of time has prevented me from doing an intensive investigation subsequently, the thought that *G. vulgatissimus* can breed in still water bodies may prompt recorders to look more closely at lakes and ponds particularly if they are within a few miles of known breeding sites.

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Exotic dragonflies in north London

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Introduction

I first met Cyril Hammond in 1979. I had been working at the Natural History Museum for only a few months when he telephoned and asked if I would help him to identify a dragonfly that he had collected recently in Crews Hill, north London. I was rather perturbed by this as I had already found his *Dragonflies Ireland* (Hammond, 1977) invaluable for identifying British Odonata and assumed that it was the last word on the subject. Yet here was Hammond himself having difficulty identifying a specimen collected in London!

When I finally examined the specimen I understood why. The dragonfly was obviously an *Anax* but not the familiar *A. imperator* Leach. Hammond explained

that it had been collected in the greenhouses of a wholesale importer of tropical waterweeds. Eventu
Rambur, a species which usually occurs in Australasia.

It has become apparent in recent years that incidents such as this are relatively common. Lieftinck (1978) was able to successfully rear five larvae of *Ictinogomphus decoratus melaenops* (Selys) which had accidentally been imported into The Netherlands from southeast Asia. Paulson (1978) noted the arrival of the asiatic species *Crocothemis servilia* (Drury) in Florida. Almost certainly it had arrived with imported aquatic vegetation and had successfully established iteself in the wild. Within seven years it had spread 150 miles (Daigle and Rutter, 1984). Similarly, in Finland Valtonen (1985) identified the adults of five southeast Asian species together with several unidentified larvae which had been inadvertently imported with tropical waterweeds. Agassiz (1981) noted five species of Odonata, together with several pyralid Lepidoptera species, of tropical origin which had been imported into Britain. The purpose of this note is to record ten further dragonfly species which have been introduced in similar circumstances into Britain.

Description of the greenhouses

The tropical waterweed importers that I visited are located at Crews Hill, north London, amongst a complex of garden centres. The site is composed of two, 100 foot greenhouses, each containing 20-30 tanks. The tanks hold about two feet of water into which is placed the waterweeds. Most of the plants were submerged but several of the tanks were packed with emergent vegetation. By sweeping the tanks with a pond net I was able to collect many Odonata larvae but also found large numbers of other insect larvae, molluscs, crayfish, amphipods and small fish. There was, therefore, plenty of food available for the developing dragonfly larvae. Adult Odonata were present throughout the year but were most numerous during the summer. The plants were imported from Singapore and Florida but it is uncertain exactly where they were originally collected.

Results

Table 1 shows a list of the Odonata collected from 1979-1985 by C. O. Hammond, D. Agassiz and myself. By far the commonest species was *Ischnura posita* (Hagen) which was collected on several visits and was frequently represented by several larvae and adults. I was unable to find evidence that any of the species were breeding at the site or that any had established a successful colony outside the greenhouses. All the species were from southeast Asia or North America except *A. imperator* and,

Table 1. Odonata accidentally imported with tropical waterweeds into a north London nursery.

	Distribution
Coenagrionidae	
Argia fumipennis (Burmeister)	N. America
Ceriagrion cerinorubellum (Brauer)	S.E. Asia, E. Indies
Enallagma signatum (Hagen)	USA
Ischnura posita (Hagen)	N. America
Ischnura senegalensis (Rambur)	Asia, Africa
Pseudagrion sp.	Old World
Aeshnidae	
Anax gibbosulus Rambur	Australasia
Anax guttatus (Burmeister)	Oriental
Anax imperator Leach*	W. Old World
Libellulidae	
Crocothemis servilia (Drury)*	Eurasia
Erythemis simplicicoides (Say)	N. & C. America
Orthetrum sabina (Drury)	Old World
Rhodothemis rufa (Rambur)*	S.E. Asia
Tramea transmarina euryale Selys*	S.E Asia
Urothemis bisignata Brauer*	Austro-Malaysia

*Species recorded by Agassiz (1981). All specimens are deposited in the British Museum (Nat. Hist.), London.

although this species is widespread in tropical Africa and as far east as India, it is also a common resident in north London and it is possible it had flown into the greenhouse from outside.

Discussion

Apparently, the waterweeds are treated with insecticides (Agassiz, 1981) although judging from the profusion of invertebrates living in the tanks this can only have a limited effect. The majority of the imported Odonata probably come as eggs inserted into the plant tissue which may protect them from the insecticides. However, the large number of Libellulidae that have been recorded and which do not lay their eggs endophytically suggest that some may arrive as larvae.

Davies (1985) rightly expressed concern at the spread of *C. servilia* in Florida since its success is almost certainly at the expense of native species. However, it is

unlikely that any of the species that have been introduced so far into north London could establish themselves in the wild because the climate is too cool. Nevertheless, if one of the more wide-ranging north American species was introduced it could find our climate acceptable and succeed in establishing a colony.

Apart from the dangers posed by the introduction of alien species there are a few benefits. Many of the larvae of the southeast Asian Odonata species are still unknown. Thus by collecting and rearing these imported larvae many useful discoveries can be made. Also what better way of spending a dreary, rainsoaked summer afternoon when all hope of observing British species has vanished than watching *Tramea transmarina euryale* Selys in full flight or the startling vividness of *Ceriagrion cerinorubellum* (Brauer)?

Acknowledgements

I would like to thank Rev. David Agassiz for introducing me to the exotic dragonfly fauna of Crews Hill and providing me with many of the specimens listed here. Thanks are also due to Mr. D. Everett of Anglo-Aquarium Nurseries for allowing me access to their greenhouses.

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Odonata in the north of Ireland 1986/87

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The general distribution of Odonata in Northern Ireland has been summarised by Nelson (1986). The main purpose of this article is to note further sightings of the rarer species and new county records.

Systematic recording and "square-bashing" by the authors and a handful of other observers has enabled a much clearer picture of Odonata distribution in Northern Ireland to emerge. The number of 10Km squares of the Irish Grid in which each species has been found, to the end of 1987, is shown in Table 1. There are a total of 186 10Km squares of the Irish Grid which are wholly or partly in the six counties of Northern Ireland (Cos Fermanagh, Tyrone, Armagh, Down, Antrim and Londonderry) and of these 142 have at least one post-1960 record.

Table 1. Number of 10Km squares in Northern Ireland in which each species of Odonata has been recorded.

	post-1960	pre-1960
Aeshna juncea	74	2
A. grandis	47	2
Brachytron pratense	29	0
Orthetrum coerulescens	4	2
Libellula quadrimaculata	56	2
Sympetrum danae	61	1
S. sanguineum	18	0
S. striolatum	80	3
Calopteryx splendens	41	3
Lestes sponsa	64	2
Pyrrhosoma nymphula	94	0
Ischnura elegans	97	4
I. pumilio	6	0
Enallagma cyathigerum	85	5
Coenagrion lunulatum	22	0
C. puella	63	1
C. pulchellum	65	3

Aeshna grandis — Discovered in Co. Down for the first time in 1986. Four sites are now known, all in the west of the county. An individual was seen near Belfast in Co. Antrim, providing the most easterly record in the Province.

Brachytron pratense — Discovered for the first time in 1986 in Cos Tyrone (three sites) and Antrim (one site). Also seen widely in Co. Fermanagh, though mostly only in ones and twos. It seemed scarcer in 1987, though several new sites were found in Co. Armagh.

Orthetrum coerulescens — Now known from at least five sites in the south of Co. Down, one of which was first discovered in 1987. A new colony was also discovered in Co. Donegal, in the Irish Republic, in 1987.

Sympetrum danae — Not rare, and can be seen occasionally in large numbers at some lowland *Sphagnum*-bogs where there are many acid pools. It also occurs on upland lakes and bogs, and on Rathlin Island. An unusual observation was the sighting of several males and females, including a mating pair, at a mesotrophic artificial lake in Co. Tyrone in 1987. It is thought that it may have bred there. Colm Ronayne (pers. comm.) recorded a similar phenomenon at a disused quarry in Co. Meath in 1987.

Sympetrum sanguineum — In 1986 one new colony was discovered in Co. Armagh, though a search of a site in Co. Tyrone, where it had been reported in 1985, drew a blank. The species was seen again at the Armagh site in 1987 and single females were recorded at two other locations in the south of the county. In 1987, it was seen several times at a site in Co. Antrim where it had been reported in 1985 and a 1983 record for the county was also discovered. However, in 1987 it was unrecorded in Co. Fermanagh despite searches by one of us (B.N.) at sites from which it was previously known. It has not been recorded in Cos Londonderry and Donegal but could exist in these counties. In Northern Ireland the species frequents lowland lakes which are well-vegetated and not too acidic or sometimes cut-over bogs with a developing fen vegetation.

Calopteryx splendens — Found widely and numerously in the southwest of the Province in 1986 (Cos Fermanagh and west Tyrone), with a single individual seen in the extreme north of Co. Antrim. However, in 1987 it seemed much scarcer, with very few records, although an individual was seen again in northern Co. Antrim. Apart from the possible effects of bad weather in June 1987, we can only surmise that the extremely dry spell in autumn 1986 may have had a deleterious effect on the larvae as rivers would have been low and made the larvae more susceptible to pollution.

Ischnura pumilio — This species was discovered at two sites, one each in Cos Antrim and Londonderry in 1985. These are the only recent records, though there are

doubtful old records from Cos Antrim and Down (Cotton, 1981). It was not recorded in 1986. However, in 1987 it turned up at three sites in Co. Fermanagh and one in Co. Tyrone. All these were in disused quarries, except one at a bog-pool in Fermanagh, and all had very shallow water as do most sites favoured by this species. The species was also discovered in 1987 in Cos Louth and Meath (C. Ronayne, pers. comm.) in disused quarries. Apart from a pair in Co. Tyrone, all the 1987 Northern Ireland sightings were of single males. The species had also been reliably recorded from Co. Donegal in 1983 (D. Cotton, pers. comm.), although there was a doubtful older record.

As one of the Fermanagh sites and the Co. Meath site had been searched on several previous occasions without success, it is believed that there are significant fluctuations in numbers. Hence several searches may be necessary in succeeding years to detect its presence. The species sometimes occurs at high altitude, providing that there is some shelter. The site in Co. Londonderry, where it was seen in 1985, is at an altitude of 210m and it has occurred at over 400m in Wales (Fox, 1987). *I. pumilio* usually flies in late June and July, although it has been recorded as late as 13th September in Co. Sligo (D. Cotton, pers. comm.). We hope to detect it more widely in the future by searching disused quarries and gravel-pits and already have some targeted.

Coenagrion lunulatum — This is the "prize" of the local Odonata fauna as it was not discovered in Ireland until 1981 (Cotton, 1982) and has not yet been found in Great Britain. So far it appears that Northern Ireland is its stronghold in Ireland, although the region may have been better searched than other areas. It has now been seen in all six Northern Ireland counties at a total of 23 sites, of which 18 are thought to support viable colonies, the remaining five records probably representing strays from nearby colonies. The majority of sightings were made in 1986, when it was discovered for the first time in Cos Tyrone, Antrim and Down, with five new sites in Fermanagh and two in Armagh. In 1987, one new site was discovered in each of Cos Tyrone, Armagh and Down.

The total number of sightings and presumed colonies is shown in Table 2. One or two of the singletons may represent the last survivors of a colony at the end of the season. This almost certainly applies to the record from Co. Down and perhaps to one in Fermanagh. Most colonies are small, with only about a dozen individuals present at one time, though two in Fermanagh and one in Londonderry (the northernmost in Ireland) have produced several dozen on occasions.

The main flight period is from early June to about mid-July, which is shorter than other *Coenagrion* species, and seems to vary from site to site as well as in different

Table 2. Number of colonies or separate sightings of single specimens of adult *Coenagrion lunulatum* (Charpentier) in the six counties of Northern Ireland.

County	No. colonies	No. singletons
Fermanagh	5	3
Tyrone	6	1
Armagh	3	1
Down	1	1
Antrim	1	0
Londonderry	1	0

years. In 1987 it was seen from 30th May (two specimens in Co. Londonderry) to 25th July (one individual in Co. Down). In the cooler spring of 1986, it was seen from 6th June (one or two in Co. Fermanagh) to 3rd August (several, including a mating pair, in Co. Tyrone). However, it has been recorded on 19th May 1982 in Co. Westmeath (Speight and Legrand, 1984).

Although we are uncertain of its exact habitat requirements, perhaps the most characteristic are mesotrophic, slightly acidic but well-vegetated, often upland lakes (100m-250m). In many cases floating vegetation, such as the water-lilies *Nuphar lutea* and *Nymphaea alba*, and pondweeds (*Potamogeton* sp.) are abundant. There is often a spongy surround or "scraw", with Bog-bean (*Menyanthes trifoliata*) and sedges (*Carex* sp.). These habitats occur mostly in Cos Fermanagh and Tyrone, although the Londonderry site and one of the Co. Down sites may be in this category. The other main habitat-type favoured by *lunulatum* occurs only on a few cut-over bogs in the east of the Province, in the Lough Neagh and River Bann basins. These usually have large pools, with a mixture of acid and more alkaline conditions, have plenty of vegetation, and are low-lying and fairly sheltered. They all support 11 or 12 other Odonata species. Two stray individuals and at least one colony were seen on fairly rich eutrophic lakes, while at least one male, possibly accompanied by a female, was seen by a main road in Co. Fermanagh!

It seems likely that at least a few more colonies of *lunulatum* may be found in the Province. As it was not seen in 1987 at a number of sites where it had previously been recorded, its absence from a locality cannot be inferred from one unsuccessful visit. It also seems likely that more new colonies may exist in the Irish Republic, especially in midland and some border counties.

Coenagrion pulchellum — In 1986 this species was discovered for the first time in Cos Londonderry and Tyrone, although its apparent absence was probably due to under-recording in the past. However, it does seem to be very scarce (as is *C. puella*)

north of Lough Neagh and there are not many colonies in Cos Londonderry or Antrim. However, in 1987 it was seen in northern Co. Londonderry and north Donegal (C. Ronayne, pers. comm.) and so its distribution does not seem to be limited by climate. It often abounds on cut-over bogs and some lakes in the south of the Province and overall is probably our most abundant species.

Other species — *Orthetrum cancellatum* was first discovered in Co. Donegal in 1984 (R. Northridge, pers. comm.) and has been seen there in 1985, 1986 and 1987. Two colonies also exist in Co. Sligo (D. Cotton, pers. comm.). Its existence in Northern Ireland is possible, if unlikely, perhaps due to the absence of marly lakes which seem to be its favourite habitat in Ireland. There remains the possibility of rediscovering *Calopteryx virgo* which was reported from near Belfast (King and Halbert, 1910) and in Co. Tyrone (Mc'Neill, 1949). A search of the area at or near the Co. Tyrone site in 1986 produced only *C. splendens*. However, there appears to be a reliable 1918 record of a few specimens in Co. Donegal (Blackwood, 1928) close to the Co. Fermanagh border. Unfortunately, the area is now submerged under a hydro-electric power scheme, but it may occur elsewhere in Co. Donegal. There also seems a possibility of the boreo-alpine species *Cordulia aenea* and *Somatochlora arctica* occurring in Co. Donegal, since both are found in Co. Kerry and West Scotland, and *C. aenea* occurs in Cork. *Lestes dryas* has been recorded as far north as Co. Westmeath (King, 1895) and, as several other species *(Orthetrum cancellatum, Sympetrum sanguineum* and *Ischnura pumilio)* are found much further north in Ireland than in Britain, it is possible that *dryas* could occur in this area.

We made two visits to Rathlin Island, Co. Antrim, in 1986 and found *Aeshna juncea, Libellula quadrimaculata, Sympetrum danae* and *Ischnura elegans* but still have several lakes to visit. Species which may occur on the island are *Sympetrum striolatum, Lestes sponsa, Pyrrhosoma nymphula* and *Enallagma cyathigerum*. All these occur on several marine islands off the west coast of Scotland (Hammond, 1983), and have been recorded on the adjacent part of the north coast of Ireland and on islands off the west and south coast (Halbert, 1912; Carter, 1973).

Apart from recording rare or local species, future recording will be centred on establishing the distribution of species which are apparently very scarce or absent in the north of the Province (approximately north of a line running west to east through the north end of Lough Neagh) that is, *B. pratense, A. grandis, S. sanguineum, C. splendens, C. puella* and *C. pulchellum*.

More intensive surveys of sites known or expected to be rich in species will also be carried out and should be of value for conservation purposes. The richest sites contain 13 breeding species and are usually either cut-over bogs, in the west of the Province, or

lakes in Co. Fermanagh. There are also two disused gravel-pits which support at least 12 species. Scraw Bog, Mullinger, Co. Westmeath may yield even more species since Speight and Legrand (1984) recorded 13 species but their list surprisingly did not include *A. juncea* or *S. danae*.

Only one of the best sites is a National Nature Reserve, but several others are on land owned by the Forestry Division of the Department of Agriculture for Northern Ireland. The main threats to lakes are pollution and destruction of waterside vegetation due to clearance or over-grazing. Cut-over bogs may often be under threat of drainage. Possibly, *I. pumilio* is the most difficult species to conserve as it seems to prefer man-made, isolated habitats such as disused quarries which often do not have other wildlife interest. *C. coerulescens*, which is only found in small seepages and flushes in the Mourne Mountains of Co. Down, may be vulnerable to drainage, pollution (perhaps by sheep), and disturbance and reclaimation of moorland.

At present, no species of Odonata is protected by law in Northern Ireland, though seven species of butterfly are protected (Rippey, 1986). Nonetheless, there is provision in existing legislation for the addition of more species of flora and fauna to the protected list. The isolated nature of the sites for *I. pumilio* and *C. lunulatum* give these species a certain amount of protection and, so far, the collecting of insects has not been a problem in Ireland but as always the chief threats are from changes in habitat.

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English names for dragonflies

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The English names listed in Tables 1 and 2 may be of interest in view of Dr. Allen Davies's proposals for a revision of the current English names which he made at the 1986 BDS Indoor Meeting at Oxford University. The names were noted whilst I researched Cheshire dragonfly records in the Grosvenor Museum at Chester. The specimens in the museum cabinets are captioned with labels which appear to have been taken from some form of publication but it has not been possible to determine whether these were cut from a printed list or from book plate titles.

The use of the term 'nymph' for the adults of both the genera *Sympetrum* and *Leucorrhinia* suggests an early date for the work since the word has passed out of current usage except for larvae. Such names as the Yellow-striped Elf and the Midsummer Fairy are very attractive. The list poses some interesting questions. Could *Leucorrhinia dubia* have been found near Dorchester? Was *Orthetrum cancellatum* originally discovered in Croydon? Sheerness, Hastings and Hull certainly seem likely points of immigration but were the continental *Lestes* species to be found this side of the Channel?

Table 1. Resident species.

Museum Captions		Current Nomenclature
Aeshna cyanea	Common Sphinx	*Aeshna cyanea*
Anax formosus	Wood Sphinx	*Aeshna juncea*
Aeshna grandis	Grand Sphinx	*Aeshna grandis*
Aeshna mixta	Marsh Sphinx	*Aeshna mixta*
Aeshna borealis	Northern Sphinx	*Aeshna caerulea*
Aeshna rufescens	Southern Sphinx	*Anaciaeschna isosceles*
Anax imperator	Superb Sphinx	*Anax imperator*
Brachytron pratense	Meadow Sphinx	*Brachytron pratense*
Gomphus vulgatissimus	Yellow-striped Elf	*Gomphus vulgatissimus*
Cordulegaster annulatus	Adders Dart	*Cordulegaster boltonii*
Cordulia aenea	Beautiful Emerald	*Cordulia aenea*
Somatochlora arctica	Arctic Emerald	*Somatochlora arctica*
Somatochlora metallica	Elegant Emerald	*Somatochlora metallica*
Platetrum depressum	Flat-bodied Dragonfly	*Libelulla depressa*
Libellula fulva	Fen Dragonfly	*Libellula fulva*
Libellula quadrimaculata	Four Spot Dragonfly	*Libellula quadrimaculata*
Orthetrum cancellatum	Croydon Dragonfly	*Orthetrum cancellatum*
Orthetrum coerulescens	Cobalt-blue Dragonfly	*Orthetrum coerulescens*
Leucorrhinia dubia	Dorchester Nymph	*Leucorrhinia dubia*
Sympetrum scoticum	Scottish Nymph	*Sympetrum danae*
Sympetrum sanguineum	Red Nymph	*Sympetrum sanguineum*
Sympetrum striolatum	Common Nymph	*Sympetrum striolatum*
Calopteryx splendens	Blue-banded Demoiselle	*Calopteryx splendens*
Calopteryx virgo		*Calopteryx virgo*
Lestes sponsa	Meadow Sylph	*Lestes sponsa*
Lestes nympha	Wood Sylph	*Lestes dryas*
Agrion mercuriale	Fork-spotted Fay	*Coenagrion mercuriale*
Agrion puella	Azure-blue Fay	*Coenagrion puella*
Agrion pulchellum	Beautiful Fay	*Coenagrion pulchellum*
Agrion cyathigerum	Heart-spotted Fay	*Enallagma cyathigerum*
Erythromma najas	Blue-tipped Fay	*Erythromma najas*
Ischnura elegans	Elegant Fay	*Ischnura elegans*
Ischnura pumilio	Forest Fay	*Ischnura pumilio*
Pyrrhosoma tenellum	Fen Fay	*Ceriagrion tenellum*
Pyrrhosoma minimum	Crimson Fay	*Pyrrhosoma nymphula*
Platycnemis pennipes	Midsummer Fairy	*Platycnemis pennipes*

Table 2. Extinct or immigrant species.

Museum Captions		Current Nomenclature
Cordulia curtisii	New Forest Emerald	*Oxygastra curtisii*
Onychogomphus forcipatus	Forcipated Elf	*Onychogomphus forcipatus*
Gomphus flavipes	Hastings Elf	*Gomphus flavipes*
Leucorrhinia pectoralis	Sheerness Nymph	*Leucorrhinia pectoralis*
Sympetrum flaveolum	Graceful Nymph	*Sympetrum flaveolum*
Sympetrum fonscolombii	London Nymph	*Sympetrum fonscolombii*
Sympetrum meridionale	English Nymph	*Sympetrum meridionale*
Sympetrum vulgatum	Hull Nymph	*Sympetrum vulgatum*
Lestes virens	New Forest Sylph	*Lestes virens*
Lestes barbara	Irish Sylph	*Lestes barbarus*
Lestes viridis	Scarce Sylph	*Lestes viridis*

I would welcome any correspondence which might throw light upon the origin and dates of these names.

Acknowledgement

I would like to thank Fiona MacKenzie for arranging access to the Grosvenor Museum collection.

Book Review

Dragonflies. Peter L. Miller. Cambridge University Press, Cambridge (1987). 84pp, £15.00 (H/b), £5.95 (P/b).

With the plethora of odonatological books that appeared in 1986, you might be forgiven for groaning "oh no, not another dragonfly book"! However, I would urge even the most financially hard-pressed dragonfly-nuts to dig a little deeper into their pockets and buy this book. Despite its relatively few pages and low cost, Peter Miller has managed to include a large amount of fascinating information on dragonfly biology, identification keys to adults and larvae, and colour plates of many of the British species.

The book appears as volume 7 in the Naturalists' Handbooks series and the underlying theme is to encourage the reader to participate in research, especially in those subject areas which do not require expensive equipment or specialised training. Consequently, throughout the book, there are suggestions on how to pursue fruitful lines of inquiry on matters such as territoriality in larvae and adults, larval respiration and sexual behaviour. There are also useful tips on how to collect and rear eggs and larvae, how to preserve and study exuviae and how to estimate population sizes or the number of adults in a migrating swarm.

The introductory chapter deals with the evolution of dragonflies, their aesthetic and economic importance and emphasises their excellence as subjects for field study. There then follows a chapter on the eggs and larvae, succintly summarising our current knowledge and pointing out gaps that the reader could try to fill. The chapter on the adult deals with all aspects of the insects' biology, behaviour and physiology. As might be expected, considering Dr. Miller's own particular area of interest, the sections on mating behaviour and sperm competition are particularly thought-provoking. The functional morphology of the male and female reproductive organs are described, as are the results of painstaking field and laboratory observations of copulatory activity. The reader is encouraged to participate in this research and *Ischnura elegans* is recommended as an especially suitable subject for study because a pair are usually so intent on mating that they will allow the experimenter (or tormentor) to capture them in a net or tether them with a looped rush stem without interrupting the wheel position.

The fundamental importance for the accurate identification of the subjects of ecological and other biological research is underlined by the inclusion of keys to the larvae and adults. Thankfully, Gardner's useful but outdated key is not presented yet again, but a new one devised by Graham Vick. The characters used in the key will

allow the accurate determination of a specimen without recourse to killing it and the ambiguities of Gardner's key have been corrected. David Chelmick's key to the adults is clear and easy to use but I am yet to be convinced of the advantages of a key over well-illustrated colour plates for field identification of adult Odonata.

The concluding chapters give practical advice on the conservation of dragonflies, study techniques and the presentation of data, and I was pleased to see that the *Journal of the British Dragonfly Society* was recommended as the most relevant journal for the publication of notes on British dragonflies.

Throughout the book are marginal notes explaining technical terms as they are introduced and also many exquisitely produced line drawings by Sophie Allington. My only real quibble concerns the colour plates which have come out rather dull and, I suspect, do not do justice to Rupert Lee's originals. These plates serve to illustrate examples of the families which occur in Britain and also to some extent the sexual dimorphism. However, my worry is that, despite the keys provided to the adults, some readers might attempt to use the colour plates to identify the British species and misidentify a species which is not illustrated. I think that a note accompanying the plates stating that not all the British species are figured would have been useful.

In conclusion, I would thoroughly recommend Peter Miller's book to anyone interested in dragonflies and to anyone with a general interest in natural history but not yet smitten with the dragonfly-bug. Quite simply it is one of the best books on dragonflies that I have read.

S. J. Brooks

INSTRUCTIONS TO AUTHORS

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Manuscripts should be typewritten using black ribbon, double-spaced, on one side of the page only and with margins at least 25 mm at the left, top and bottom; text pages should be numbered. Footnotes should be avoided.

Words that are to appear in italics (e.g. names of genera and species, though not of families) should be underlined.

Use of these terms is acceptable: 'exuvia' for cast skin (plural 'exuviae'); 'larva' (instead of 'naiad' or 'nymph'); 'prolarva' to designate the first larval instar.

References cited in the text should be in the form '(Longfield, 1949)' or '. . . as noted by Longfield (1949).' All references cited in the text (and only these) should be listed alphabetically at the end of the article in this form:

Hammond, C. O. 1983. *The dragonflies of Great Britain and Ireland.* 2nd edition (revised by R. Merritt). Harley Books, Colchester. 116 pp.

Longfield, C. 1949. The dragonflies of the London area. *The London Naturalist* 28: 90-98.

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