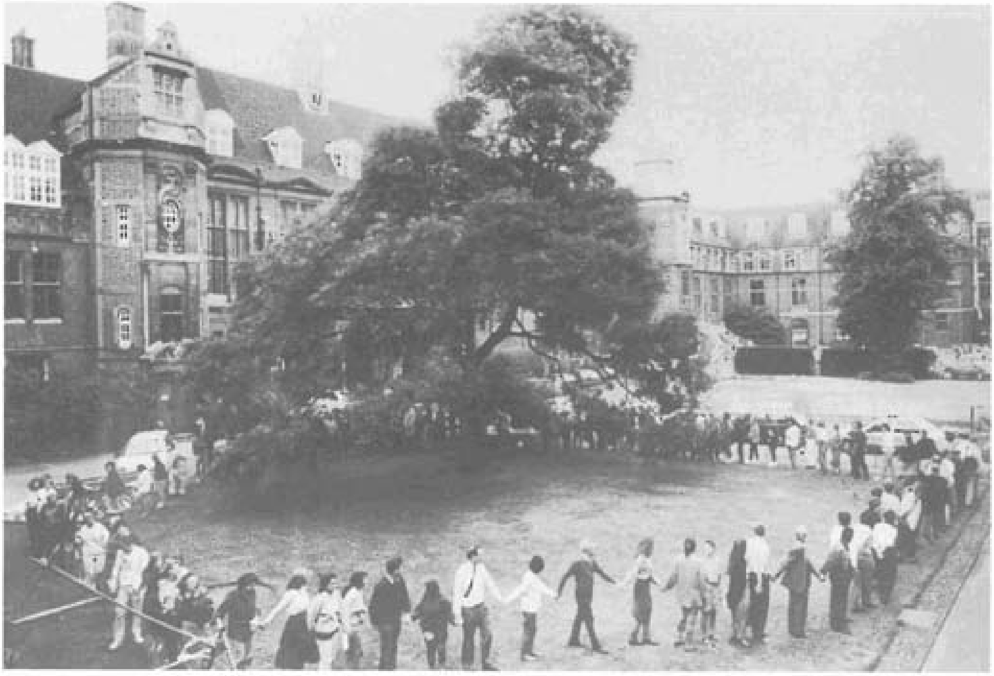
Nature in Cambridgeshire

No 38 1996



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Cover photograph: Students on the lawn by the Scholars' or Pagoda Tree on the Downing Site, Cambridge (see p. 23)
Department of Plant Sciences

Photos opposite: Members of the University dancing round the tree on 19 June 1992 — Cambridge Newspapers Ltd
Children dissecting owl pellets (see pp. 65–69) — G. Alan Revill

Copies of *Nature in Cambridgeshire* may be obtained from the Herbarium, Department of Plant Sciences, Downing Street, Cambridge, CB2 3EA (price £3.00 by post). Copies of many earlier issues are also available. Articles for consideration for No. 39 should be submitted to the Editor, Mr P.H. Oswald, at 33 Panton Street, Cambridge, CB2 1HL, by 31 December 1996.

ISSN 0466-6046

Editorial

This year I have succeeded in having *Nature in Cambridgeshire* ready for the press in May again, after several years when it came out at the end of the summer. We are delighted by the range of articles submitted and hope that our readers will enjoy their summer reading. We plan to produce offprints of Dr Oliver Rackham and Dr David Coombe's paper on Madingley Wood, with its plant list spanning four centuries compiled with the help of Mrs Gigi Crompton, to follow the earlier offprints of papers on Oxlips and 'maritime' plants of Cambridgeshire roads.

Last year's articles on black Grey Squirrels and a Swallowtail butterfly and caterpillars in Girton evoked some further observations. Mr Henry Arnold, Joint Mammal Recorder for Huntingdonshire, says that the first report of melanistic squirrels in 'old' Hunts was received in 1983 from Hemingford Grey and that since then there have been reports almost every year from the area between Huntingdon and St Ives, with outlying records at Glatton and Abbotsley. He has little doubt that an unrecorded introduction was responsible and suggests that black squirrels may have come to Girton from the west rather than the south. Mrs Jean Benfield saw two black squirrels in Hardwick Wood on 7 November 1991 and has seen them there on several occasions since, as well as at Sandy, Bedfordshire, in January this year.

Mr Brian Gardiner writes that he thinks it likely that the Girton Swallowtail was an escapee from a captive breeding colony of the continental subspecies, *Papilio machaon gorganus*, which is widely available commercially and the caterpillars of which are more likely to feed on parsley and dill. When he was maintaining the stock of subspecies *britannicus* used for the first attempt to reintroduce it at Wicken Fen in the 1950s and 1960s, this was kept in a glasshouse at the Department of Zoology's Field Station in Storey's Way, Cambridge. Larvae were twice found on the only bed of Fennel *Foeniculum vulgare* in the vicinity, some 200 yards away on the far side of a belt of poplars and a small orchard. On the first occasion 212 larvae were found, suggesting that more than one escapee butterfly must have been involved. He suggests that this perhaps says something about the extraordinary ability of butterflies to seek out isolated plants on which to lay their eggs.

Since I completed my article on two species of crane's-bill, Miss Liza Steel has shown me a further colony of Shining Crane's-bill in a passageway off Alpha Road, Cambridge, and in a neighbouring garden (TL 44725939).

On 5 May Dr Max Walters and I were among those to attend a ceremony in memory of the late William and Dora Palmer, when their daughter Kate Miller opened a ride in part of Gransden Wood acquired by the Wildlife Trust with their bequest. William was one of the founders of *Nature in Cambridgeshire*, to which he contributed many of his excellent photographs, and its 'relaunch' in 1986 was helped by a 'pump-priming' grant from his Memorial Appeal.

We express our warm thanks to Mrs Anne James, who has handled the distribution of *Nature in Cambridgeshire* so efficiently and is now handing over this task to Mrs Jane Bulleid, whom we welcome onto the Editorial Board as Membership Secretary.

Philip Oswald

Temporal and spatial patterns of temporary pond organisms

Laurie E. Friday, Robert A. McCall, Harriet L. G. Elson & Martin G. Walters

Introduction

The temporary ponds at the Whittlesford/Thriplow Hummocky Fields SSSI have been the subject of considerable interest over the past three decades. Studies have generally concentrated on the occurrence of certain species found in temporary water-bodies, either in the wet phase (e.g. the Fairy Shrimp *Chirocephalus diaphanus*: Walters, 1972, 1978) or in the dry phase (Grass-poly *Lythrum hyssopifolia*: Preston & Whitehouse, 1986; Preston, 1989). Species which are characteristic of temporary ponds show various adaptations by which they avoid the adverse phase, escaping either through space (dispersal to neighbouring suitable habitats) or through time, as desiccation-resistant propagules (seeds, spores or eggs).

Most temporary ponds in temperate regions are wet in winter or early spring but dry in summer. However, in exceptionally dry years or where ground-water abstraction lowers the water table, pond basins may fail to refill in winter. Pond A at the Whittlesford/Thriplow SSSI has had a chequered history in this respect, disappearing for periods of several years during the 1980s and early 1990s (see Figure 2).

The length of time for which water is present and the predictability of this 'hydroperiod' determine the types of life-history strategies by which organisms may complete their life-cycles and attain the dispersive or dormant stage before the water disappears (see Williams, 1987). It follows that the nature of the hydroperiod will exert a powerful influence on the species assemblages to be found in temporary ponds and on the ecology of the aquatic community as a whole.

Most studies of the distributions of temporary pond organisms have focussed on the pond basin itself. One might expect a greater concentration of dormant aquatic organisms in areas that are frequently flooded, when compared to more raised areas, both within the pond basin and in the surrounding area. This is because the dormant stages inevitably have only a limited lifespan and there must be a decline in numbers of viable propagules in the soil 'bank' over time. Populations of dormant propagules can be replenished only by flooding, which releases a new generation to grow and reproduce before the next dormant phase. It may be postulated that prolonged drought periods may so deplete the soil 'bank' that certain species may fail to re-establish breeding populations when the basin eventually fills.

Organisms with effective dispersal could, however, survive in suitable habitats beyond the pond basin and disperse back when the wet phase is re-established. Such a strategy is commonly found among insects of temporary pools in areas with patchy rainfall patterns where pools come and go in a kaleidoscopic fashion (for example, the midge *Chironomus imicola* in African rain-pools: McLachlan, 1983).

During the dry phase of a temporary pond, one might expect aquatic species to show one of three possible distributions, depending on the life-history strategy of the organism concerned:

	Distribution of propagules	*Organism characteristics*
A:	Only in pond basin	Propagules desiccation-resistant but with poor dispersal
B:	Evenly dispersed in and around pond basin	Propagules desiccation-resistant, with good dispersal
C:	Not found in dry basin or immediate surrounds, but in nearby aquatic habitats	Propagules not desiccation-resistant but with good dispersal – probably emigrating as adults

In addition, there might be patterns within the pond basin, with different numbers of propagules surviving in the deeper parts of the basin, which retain water for longer, compared to the shallower parts.

In this study, we examine two questions relating to the distributions of temporary pond organisms at Whittlesford:

1. Is the *temporal* distribution of *Chirocephalus diaphanus* in successive wet phases affected by the duration of preceding dry phases?

2. What is the *spatial* distribution of dormant propagules of aquatic organisms during the dry phase?

Study site

Ponds A and B lie in the corner of an arable field near Fowlmere (Walters, 1972) (Figure 1). The ponds are of periglacial origin (Preston, 1989) and are acquifer-fed, flooding when the local water table is above a certain height (Walters, 1978). The basin of Pond A is larger (approximately 45 x 45 m) and deeper than that of B; during 12 visits when A was full, on only four occasions was B also holding water (Walters, 1978). Precipitation may lead to very temporary flooding of the basins, insufficient for any multicellular organism to complete its life-cycle. The bedrock is calcareous, overlain by clay (Forbes, 1965); water filling the hollows is therefore base-rich with a high pH.

Temporal patterns

The hydroperiod record of Pond A, with monthly rainfall records for the Cambridge Botanic Garden, is shown in Figure 2. As far as we are aware, Pond A was absent for six prolonged periods during the past three decades – three years to November 1974; 19 months to February 1977; 19 months to February 1980; three years to April 1983; four and a half years to February 1988; and five years to April 1993. During this period, the wet phase lasted on average three months but ranged from eight months (October 1968 to May 1969) to as little as one month (mid April to mid May 1993). The reappearance of the pond has generally been preceded by exceptionally heavy rainfall in the previous autumn or winter. The total rainfall in the six months from October to March is a good predictor of the duration of Pond A: a threshold of around 280–300 mm must be exceeded before the pond will reappear (Figure 3).

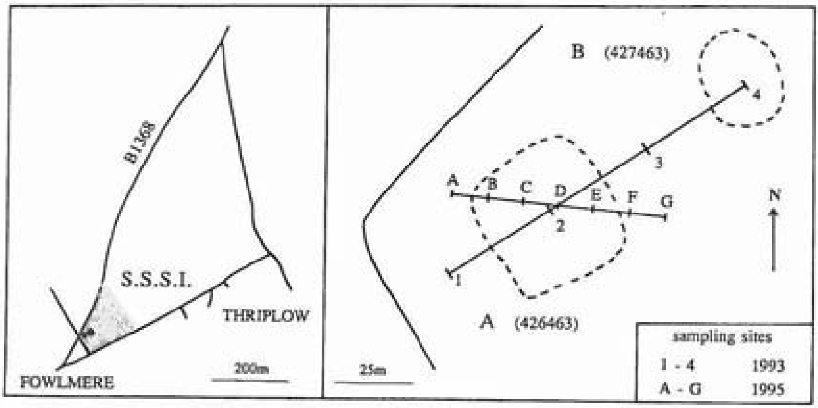

Figure 1: Whittlesford/Thriplow Hummocky Fields SSSI: plan of Ponds A and B showing sampling points for the two studies of dormant propagules

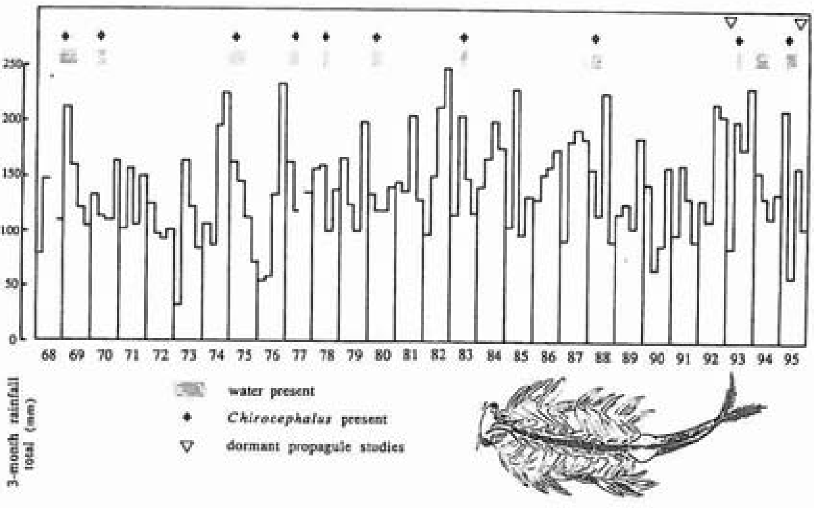

Figure 2: Hydroperiod record for Pond A, 1968–1995: seasonal rainfall totals (January–March, April–June, July–September, October–December) for Cambridge University Botanic Garden, sightings of adult or juvenile *Chirocephalus diaphanus*, and the times of the two studies of dormant propagules. Drawing of *Chirocephalus diaphanus* by Graham Easy.

Each time the pond has reappeared, the presence or absence of the Fairy Shrimp *Chirocephalus diaphanus* has been noted. With the exception of 1994, the shrimp has reappeared in each wet period (Figure 2). The pond frequently contains other crustaceans also – in 1988 the cladocerans *Daphnia magna, Simocephalus vetulus* and *Macrothrix laticornis/hirsuticornis* and the copepod *Diaptomus castor* (Preston, 1989) and in 1994 *S. vetulus, M. laticornis/ hursuticornis* and the copepod *Cyclops strenuus*.

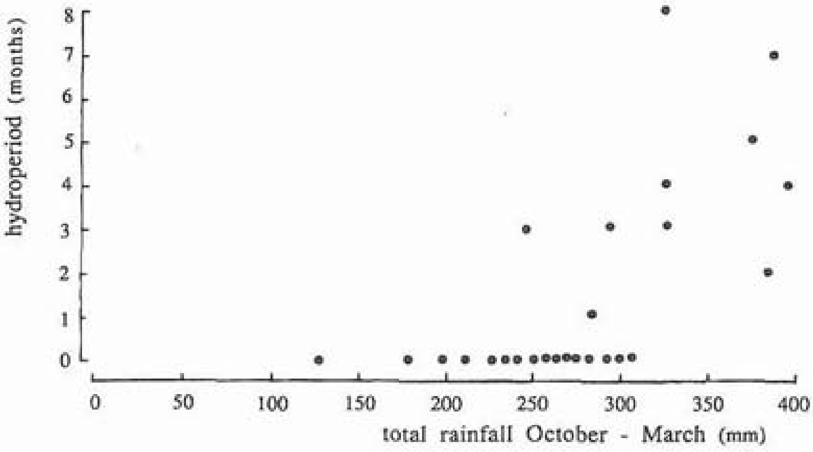

Figure 3: Approximate hydroperiod of Pond A in relation to total rainfall in the preceding winter

Spatial patterns

Pond hollows v. surrounding dry areas

Soil samples were taken at the end of the 1988–1993 dry period, in early spring. The field was sown with a cereal crop at the time. A line was drawn through the basins of Ponds A and B in the direction of the prevailing wind and four two-metre transects drawn at right-angles to this:

1. upwind of Pond A hollow;
2. in the centre of Pond A hollow;
3. midway between Ponds A and B;
4. in the centre of Pond B hollow.

Ten samples were taken at 20-cm intervals along each of these transects, each consisting of a 5.7-cm diameter core of the top 10 cm of soil. In the laboratory, each sample was weighed in its container and thoroughly wetted with 110 ml of filtered rainwater to a water depth of about 5 cm. A further five containers were filled with rainwater only. All the containers were placed on white paper on a north-facing windowsill with lids fully loosened.

The development of microscopic communities in the water above the soil samples was monitored every few days by removing 30 µl of liquid from the soil–water interface with a Gilson pipette and examining the sample at x100. The organisms were identified wherever possible to genus.

Macroscopic organisms, such as charophytes and crustaceans, were recorded

31 days after wetting.

The pH and conductivity of water in each container was measured periodically with Whatman meters. A simple optical transmissivity meter was devised to monitor development of algal growth (which reduces light transmission) in the samples.

Results

The microscopic organisms emerging after wetting are shown in Table 1.

Table 1: Microscopic organisms emerging from wetted soil samples in 1993

Category	Genera recorded
'Large ciliates' (> 150 µm)	*Amphileptus*
	Holophyra
	Lachrymaria
	Paramecium
	Stylonychia
'Small ciliates' (< 150 µm)	*Colpidium*
	Colpoda
	Tetrahymena
Peritricha	*Vorticella*
Diatoms	*Fragilaria*
	Meridion
	Navicula
	Nitzschia
	Synedra
Other unicellular green algae	*Chlorella*
	Dictyosphaerium
	Pediastrum
	Scenedesmus
Filamentous green algae	*Draparnaldia*
	Oedogonium
	Spirogyra
Cyanobacteria	*Anabaena*
	Chroococcus
Heliozoa	*Actinosphaerium*
Rhizopoda (amoebae)	undetermined

The number of micro-organisms (total of all categories) increased over time as shown in Figure 4; numbers appeared to approach a plateau after about four weeks. There was, however, great variation between samples from the same site and, in several containers, a dense mucilaginous layer formed over the surface of the soil. Differences between sites in hollows and in the areas between hollows (dry areas) in the numbers of micro-organisms in different categories were analysed by single factor analysis of variance (ANOVA). Very few significant differences were found: 'large ciliates' were more numerous in hollows (after 10 days: $F = 5.85$, $p < 0.01$; after 28 days: $F = 9.99$, $p < 0.01$), as were heliozoans (after 28 days: $F = 7.11$, $p < 0.01$).

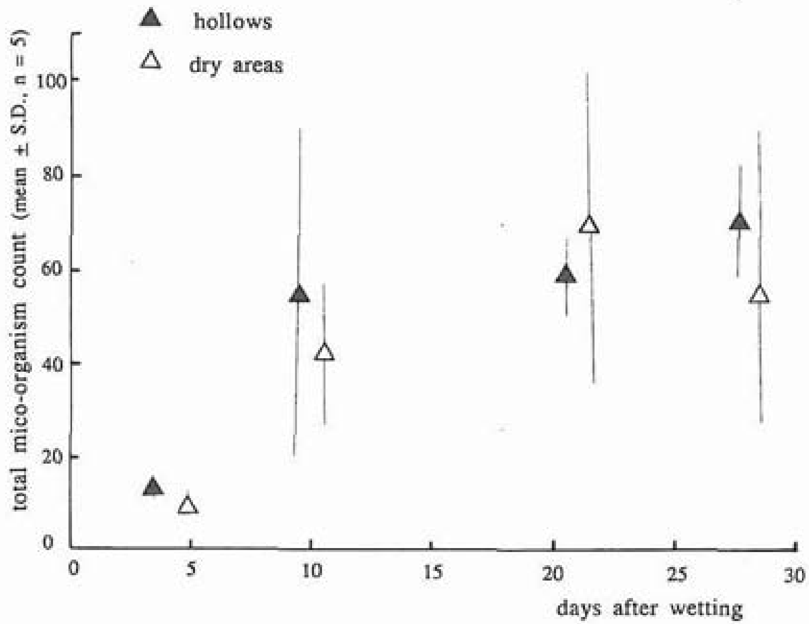

Figure 4: Total micro-organism counts in samples from hollows and surrounding 'dry areas' in 1993 at intervals after wetting

There was a rapid decline in optical transmissivity in most samples after day 17, caused by filamentous algal growth. Samples from hollows produced significantly more algal growth than those from dry areas from day 9 onwards, although variation between samples increased with time (after 9 days: $F = 8.34$, $p < 0.001$; after 27 days: $F = 4.15$, $p < 0.05$).

The first multicellular animals to emerge, on the third day after wetting, were tardigrades and nematodes. No tardigrades were recorded after day 3, but nematodes continued to appear till day 21. Crustacea began appearing around day 14, with *C. diaphanus* the first species to emerge. All Fairy Shrimps were from hollows samples; although the ostracod *Bradleystrandesia fuscata* (formerly *Cypriocercus fuscatus*) and the cladoceran *Macrothrix laticornis/ hursuticornis* were found in both hollows and dry areas samples, the number of samples from which they emerged was greater in the hollows (Table 2).

Charophytes (which were not identified to species) began to appear in the samples around day 40. They occurred in all ten samples from the basin of Pond A, in six samples from Pond B, in one sample upwind of the ponds and in four downwind of Pond A.

The pH of the water above the samples increased steadily over time: all samples started at approximately pH 8.2 and reached 8.7–8.9 by day 27. There were no significant differences in conductivity at the start of the experiment but conductivity dropped slightly in the dry areas samples to be significantly lower than in the hollows samples after 27 days.

Table 2: Emergence of animals (counts taken on day 3 for nematodes and tardigrades and day 31 for Crustacea)

Species	No. of individuals (No. of samples in which they occurred)	
	Hollows	Dry areas
Bradleystrandesia fuscata	5 (4)	1 (1)
Chirocephalus diaphanus	3 (3)	0
Macrothrix laticornis/hursuticornis	42 (2)	40 (1)
Tardigrada (sp. undetermined)	2 (2)	2 (2)
Nematoda (sp. undetermined)	10 (3)	7 (5)

No copepods or rotifers were recorded in any of the containers.

Variations across a dry pond basin

Soil samples were taken from the dry basin of Pond A in autumn 1995, when the field had been ploughed and carried a beet crop. The basin was clearly delineated by a transition between the strongly growing crop and thin beet merging into ruderals. The main vascular plant species recorded in the dry basin, in descending order of abundance, were *Lythrum hyssopifolia*, *Persicaria maculosa* (*Polygonum persicaria*), *Equisetum arvense*, *Tripleurospermum inodorum*, *Cirsium arvense* and *Plantago major* subsp. *intermedia*.

Sets of five cores were taken, as described above, at 8–10-m intervals along a transect running approximately west to east across the dry basin of Pond A (see Figure 1). Sites A and G were outside the basin. At its deepest point (near site D), there was a thin surface pan of mud produced by evaporation. The samples were transported to the laboratory and treated as before, except that 200 cm^3 of deionised water was used for wetting.

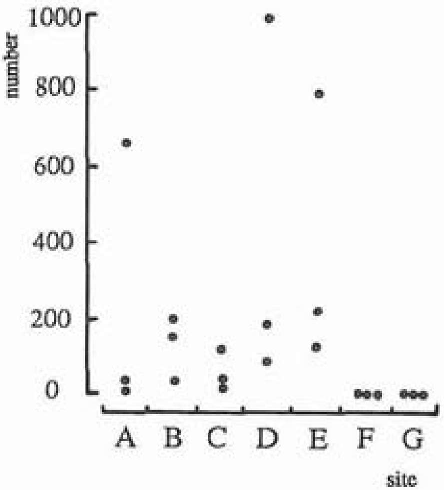

Figure 5: Counts of *Scenedesmus acutus* in samples taken across the dry bed of Pond A in 1995 (sum of six counts per sample taken at intervals of up to 35 days after wetting)

Results

Micro-organisms emerging from the samples are listed in Table 3.

Table 3: Micro-organisms emerging from wetted soil samples in 1995

Category	Genera recorded	Category	Genera recorded
Ciliates	*Colpidium*	Other unicellular green algae	*Ankistrodesmus*
	Colpoda		*Chlorococcus*
	Paramecium		*Pleurococcus*
	Stylonychia		*Scenedesmus acutus*
Peritrichs	*Vorticella*		*S. quadricauda*
Flagellates	*Bodo*	Volvocales	*Eudorina*
	Euglena	Cyanobacteria	*Chroococcus*
	Peranema		*Nostoc*
Pennate diatoms	*Biddulphia*	Heliozoa	*Acanthocystis*
	Cymbella		*Actinosphaerium*
	Epithemia	Rhizopoda	*Acanthamoeba*
	Navicula		*Naegleria*
	Nitzschia		*Nuclearia*
	Stauroneis		*Saccoamoeba*
Desmids	*Closterium*		

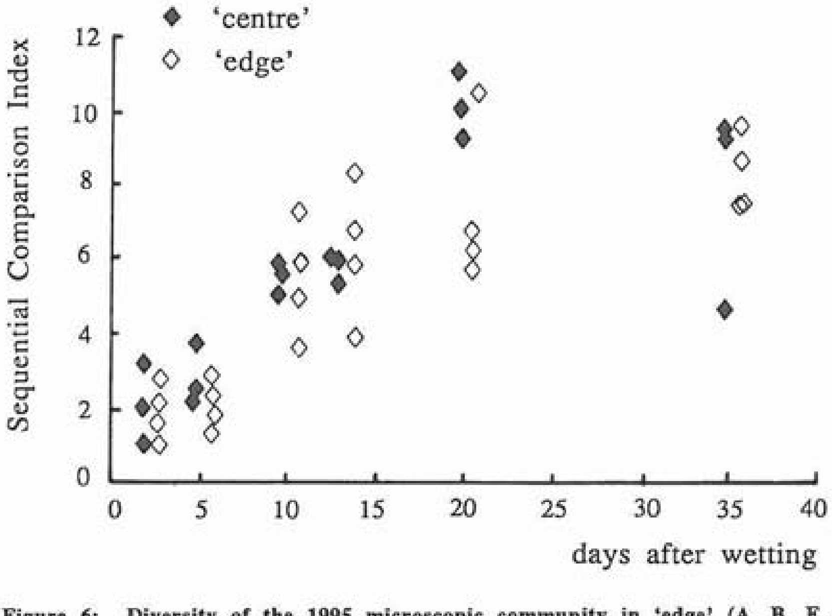

Figure 6: Diversity of the 1995 microscopic community in 'edge' (A, B, F, G) and 'centre' (C, D, E) samples at intervals after wetting

Few patterns were noted in the emergence of organisms in different parts of the pond basin. The main differences were between sites F and G, on the margin of the basin, and other sites; the chlorophyte *Scenedesmus acutus* was abundant in most samples from the pond basin, but scarce in F and absent in G (Figure 5), while various small diatoms were abundant in F and G but absent from the centre of the basin.

The diversity of the microscopic communities developing in the sample jars was measured at intervals by calculating a Sequential Comparison Index (Cairns & Dickson, 1971). This is based on viewing organisms in a random sequence and scoring whether the organism currently in view is the same or different from the last one seen. The number of 'runs' of similar organisms relative to the total number of organisms viewed gives a measure of diversity. The changes in diversity of the microscopic community after wetting are shown in Figure 6. In each sample, diversity increases sharply between days 2 and 10 after wetting, then slows down and reaches a plateau at about day 20. There is no obvious difference between sites.

Of the macroscopic organisms, the first to emerge was *Chirocephalus*, on day 9 (Table 4).

Table 4: Macroscopic organisms recorded in 1995/96

Species	Site (No. of samples in which species occurred)			
Chirocephalus diaphanus	A (1)	D (1)		
Bradleystrandesia fuscata		D (2)	E (1)	
Cypridopsis vidua		D (1)		
Dolerocypris fasciata		D (2)		
*Macrothrix hirsuticornis**				F (1)
Charophytes		D (1)	E (3)	F (3)

**Macrothrix hirsuticornis* Norman & Brady is distinguished from *M. laticornis* by its smooth shell edge.

The three ostracod species identified are all known from temporary ponds: *Bradleystrandesia fuscata* and *Cypridopsis vidua* are both common in Britain, but *Dolerocypris fasciata* has been recorded in Britain only from East Anglia.

Discussion

The reappearance of the aquatic habitat in Pond A is irregular but not entirely unpredictable. Winter rainfall data give good indications of whether we may expect the pond to fill in the following spring and, to some extent, predict the duration of the pond. Only 142 mm of rain fell in the period October 1995 to January 1996, which led us to predict that, unless there were a further 140 mm during February and March 1996, the pond would not reappear this year. In the event, there were not, and the pond has not reappeared.

If it is possible for biologists to predict the behaviour in Pond A, is it also possible for the organisms that rely on the presence of water for the successful completion of their life-cycle to do so? The different types of organisms inhabiting temporary ponds adopt a range of strategies; for those at one end of the spectrum, 'prediction' would seem unnecessary, while for those at the other, some element of 'prediction' is vital.

For unicellular organisms with extremely rapid life-cycles a wetting of even very short duration is probably enough for growth, reproduction and survival. Many protists form drought-resistant cysts that may be carried by air currents and some can maintain populations in the thin film of water that surrounds soil particles. Cysts of the common soil ciliate *Colpoda* may remain viable over 38 years of dry storage (Maxwell, 1961) and *C. cucullus* may excyst, grow, reproduce and re-encyst in the time it takes for dew to evaporate from the surface of vegetation (Mueller & Mueller, 1970). Diatoms also have the ability to form resistant stages (hypnospores); when desiccation threatens, they tend to concentrate oils within the cell before burrowing away from the surface. Many species reproduce in soil on merely moist surfaces.

It is perhaps not surprising that most groups of microrganisms were not found in any greater numbers in the dry pond basins than elsewhere. That is to say, their distribution in the study field is more or less ubiquitous, or a 'type B' distribution (see Introduction). This result seems to lend support to the idea that the microscopic community that lives on and in the surface millimetres of soil (the epipelon) is continuous with that of temporary waters (see Round, 1981). However, some of the genera identified here contain many species, each with a particular ecology; unless individual species are identified, it is not possible to say whether the communities are distinct or continuous. Where this has been possible, some patterns have emerged: for example *Scenedesmus acutus*, a 'pond' species, was found almost exclusively in the hollows samples.

Both filamentous algae and charophytes were more common in pond sites than in the surrounds. The filamentous species either form resting spores (e.g. Oedogoniales) or survive within a mucilage sheath (e.g. *Anabaena*). Ornamented zygospores were common in soil examined from Pond A samples especially. Charophytes also produce small, light, highly resistant resting spores, so this group's type A distribution is rather surprising. However, charophytes were amongst the last organisms to appear in the samples; this suggests that prolonged flooding (which would not be attained in surrounding areas) may be required before emergence.

Nematodes, tardigrades and rotifers are peculiar among multicellular animals in being able to form desiccation-resistant dormant stages at any point in their life-cycle. In the dormant stage, the metabolic rate drops virtually to zero and the animals may survive for decades in a state known as cryptobiosis or anhydrobiosis (Crowe & Cooper, 1971). These three phyla are essentially aquatic but, by virtue of their extraordinarily adaptable response to water loss, are able to inhabit environments where drying may happen very rapidly and unpredictably; they are the only multicellular organisms that may reliably be encountered in moss clumps growing on roofs and walls (see Corbet & Lan, 1974). Rotifers were not recorded in this study, but tardigrades and nematodes both showed type B distributions, with propagules found both in the pond basins and in the surrounding area. This may be the distribution to be expected for organisms with highly desiccation-resistant, small, light propagules. However, this strategy will work only when these propagules have a high chance of surviving to produce the next generation; otherwise all propagules outside the pond basins will be wasted. In the case of tardigrades and aquatic nematodes, the ability to go into diapause at any stage makes it possible for them to survive occasional wettings by rain in 'dry areas' until they are transported back into a more favourable habitat.

Crustaceans, however, diapause as eggs and require weeks of flooding if they are successfully to complete the life-cycle from resting egg through to resting egg. Timing is critical, and a type A distribution is to be expected. Although an individual may die when a pond dries, its genetic immortality is preserved if it can produce at least some offspring that can survive the dry period and themselves reproduce in future. However, the length of the wet period may be unpredictable and isolated heavy rain showers may produce 'false flooding', so a very flexible approach may be needed.

Chirocephalus diaphanus has a life-history strategy that accommodates unreliable wet periods. Eggs that have not been dried hatch after 13–16 days at 15°C and may attain maturity in a further 14–16 days (Hall, 1953). Adults emerging early in the wet period therefore have the possibility of producing a second generation if the pond persists. However, eggs produced towards the end of a wet period may dry out and undergo interrupted development (diapause); of these, a high proportion do not hatch after 15–16 days of wetting, but may hatch erratically over a period of up to 70 days or remain viable but unhatched (Hall, 1953). Flexibility of this sort within the offspring of an individual female would mean that, in the next wet period, her eggs would hatch over a wide time interval; although most of her offspring may be caught out by the pond drying up in mid life-cycle and so die, at least some of her offspring would complete their life-cycle and produce their own eggs at a time that matched the hydroperiod. Her grandchildren would similarly show staggered hatching and so her genetic lineage would continue. She has played a 'bet-hedging' game, not putting all her eggs 'in one basket'.

This sort of life-cycle is known in other members of the fairy shrimp family and may take extreme forms. *Streptocephalus vitreus* lives in African rainpools that are very unpredictable in their hydroperiod and in which 'false flooding' is common: within single clutches of dried eggs, some eggs hatch after a single wetting, but others may require redrying and rewetting up to eight times before they can be induced to hatch (Hildrew, 1985). Hildrew was also able to show that *Streptocephalus* females preferentially laid their eggs around the 'high tide' mark of the rainpools; eggs in this position would be inundated enough to induce hatching only when the pool was brimfull and therefore likely to last for weeks rather than days. Such a distribution is likely to be found where there is a high probability of 'false flooding', which is perhaps less likely in groundwater-fed ponds in the temperate zone than in tropical rainpools. There is no evidence from the present study that *Chirocephalus* lays eggs prefentially at the pond margin.

What is the size of the *Chirocephalus* 'egg bank' in the Whittlesford/Thriplow ponds? This study provides a very rough minimum estimate of viable egg density in a dry pond after nearly five years of drought: the 20 mud samples taken in the pond basins in 1993 yielded three Fairy Shrimps, which is equivalent to one viable egg per 80 cm^2. However, this is likely to be an underestimate of the true size of the egg bank because we do not know how many more shrimps may have emerged had we repeatedly dried and rewetted the samples of mud. Extrapolating to the total extent of the basin and assuming a random distribution of eggs across the basin, the egg bank of Pond A may have contained in the region of 30,000 viable eggs. These need not all be the offspring of animals present in the last wet phase because variable hatching produces a curious situation: the offspring of many generations may lie dormant together in the egg bank. When wetting occurs, these mixed generations may be released simultaneously and breed together. In the case of the copepod *Diaptomus sanguineus*, hundreds of generations may be represented in the egg bank (Hairston, van Brunt & Kearns, 1995).

How long can dried *Chirocephalus diaphanus* eggs remain viable? The observations on Pond A suggest that dry periods of at least five years may elapse and a new generation of Fairy Shrimps will be produced when the pond returns. We have no information on the rate of loss of viability of eggs and may simply have to rely on natural experiments, such as those occasioned by the past few drought years, to provide data. However, we do have evidence of one likely cause of depletion of the soil bank: although *Chirocephalus* eggs show a type A distribution, those of the other crustaceans were also found in the dry areas between ponds. These eggs may have been removed from the pond basin in mud carried on the plough. Eggs ending up in the dry areas are effectively lost from the population, having no possibility of producing a new generation. It is certain that Fairy Shrimp eggs could also be lost in this way; one of us has hatched a shrimp from the mud carried home on a Wellington boot. We do not recommend, however, that ploughing ceases in the SSSI; there is good evidence that ploughing plays an important role in maintaining the unusual flora of the dry phase (Preston, 1989).

Acknowledgements

We thank Mr Oliver Walston and English Nature for permission to work on the SSSI. *Chirocephalus diaphanus* is a protected species under Schedule 5 of the Wildlife and Countryside Act 1981; this project was carried out under licence from English Nature.

We are grateful to John Lester, Colin Denston, Barbara Bottrill, Brett Roden and Peter Dyer, who assisted with laboratory or field work, Mick Frogley, who identified the ostracods, and the staff of the Cambridge University Botanic Garden for making available their rainfall data.

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Wicken Fen – an appeal for floral and faunal records

This year will see the publication of a new book on the history, ecology and management of Wicken Fen – *Wicken Fen: the making of a nature reserve*, edited by Dr Laurie Friday and published by Harley Books, Colchester.

While compiling the floral and faunal lists that appear as an appendix to the book, the Wicken Fen Local Management Committee has been struck by the uneven coverage of different groups of organisms. While the lists of some groups such as vascular plants are probably nearly complete, it seems unlikely that we shall ever achieve full coverage of others such as the more problematical groups of insects (for example parasitic Hymenoptera) and some microscopic animals (for example Tardigrada, for which we have no Wicken records at all). Aphids and ants are among groups that are notably under-recorded.

Our lists depend largely on the interests of those associated with the Fen and on occasional visits by experts from further afield. We present them with the caveat that omission does not imply absence, and we hope that readers will feel challenged to fill gaps. If you have Wicken Fen records of less well-known groups hidden away in a field notebook, please send them to either the Botanical Secretary, Dr J.O. Mountford, or the Zoological Secretary, Dr M. de L. Brooke, c/o Wicken Fen, Lode Lane, Wicken, Ely, Cambs.

Laurie Friday

Corrigenda: The Editor regrets that important authors' corrections were not incorporated in 'The Cambridgeshire Dragonfly Survey 1991–1993' by Val Perrin & Ian Johnson published in *Nature in Cambridgeshire*, No. 37. The fifth sentence of the second paragraph should be: "Lucas (1900) also gives localities in Cambridgeshire for 23 species, of which at least 15 were recorded during the 1920s at Wicken Fen (Lucas, 1925, 1928)." Five references in the text to Fryer (1938) should be to Imms (1938), as in the list of references. A further reference should be added here: "Lucas, W.J. (1900). *British Dragonflies*. Upton Gill, London."

Thermokarst landforms in the Cambridge area

Steve Boreham

Introduction

Thermokarst landforms have been recognised in Cambridgeshire by Burton (1976, 1987) from the western margin of the fenland and by West (1991) at Grunty Fen and elsewhere in southern Fenland. They are represented by near-circular depressions and larger flat-bottomed embayments cut into Jurassic or Cretaceous clay- or silt-rich bedrock and surrounded by low, rounded hills. It appears that these features were formed during the Devensian (the last cold stage), or in some cases in earlier cold stages, by the same processes that operate in arctic thaw lakes today. Their formation has been independent of past fluvial processes which have formed separate terrace aggradations. This study includes a brief description of thermokarst processes, details the geological setting of the thermokarst embayment at Grunty Fen described by West (1991), and identifies similar features south-east of Cambridge, near Swavesey, and at several other localities in southern Cambridgeshire.

What is thermokarst?

During the Middle and Late Devensian, periglacial conditions with permafrost and patterned ground affected southern Britain. The erosional processes that operate under these conditions can cause substantial depression of the land surface and include thermo-abrasion, thermo-denudation and thermokarst. The thermal and mechanical energy of water gives rise to thermo-abrasion. Similarly, the thermal energy of the air and solar radiation on slopes exposed at the edge of a water body result in thermo-denudation. In addition, the thawing of ice-rich sediment causes thermokarst (West, 1991). The rate of slope recession (backwearing) due to these processes in Siberian reservoirs today may be up to 10 metres a year (Are, 1979; Are, Balobayev & Basikov, 1979). West (1991) suggested that at more southerly latitudes there would be a higher summer heat gain, which could cause even greater erosion. These effects would be especially severe where the water table was high and the silt- or clay-rich bedrock unprotected by overlying Pleistocene sediment.

Formation of thermokarst features

Thermokarst landforms probably originate along pre-existing minor lines of drainage. Surface water from springs and from the melting of ground ice may accumulate to form a thaw lake, which becomes enlarged into a roughly circular depression through the action of thermokarst and other processes. This is similar to the way Czudek & Demek (1970) envisaged the formation of 'thermocirques' in Siberia. Pleistocene sediments overlying bedrock, or changes in bedrock lithology may give rise to the spring-lines which feed thaw lakes and yet may protect the surrounding clay bedrock from thermokarst processes. As the lake level rises, water may escape at the lowest point in the encircling hills, forming a narrow outflow channel. The continuation of backwearing leads to an enlargement of the depression, often with preferential erosion at right angles to the prevailing wind direction (Mackay, 1963; Harry & French, 1983) creating an elongated flat-bottomed embayment, often called an 'alas' (Czudek & Demek, 1970). Embayments containing thaw lakes have been noted from various localities in the Arctic foothills of Alaska (Chapman, Detterman & Mangus, 1964; West, 1991) and from the Canadian Arctic (Harry & French, 1983). West (1991) suggested that the continued elongation of an embayment or the joining of two embayments across a col could result in the formation of a channel. Thus thermokarst landforms may be represented by small circular depressions, larger possibly elongate embayments, and channels formed by the extension of a single embayment or by coalescence of several such embayments.

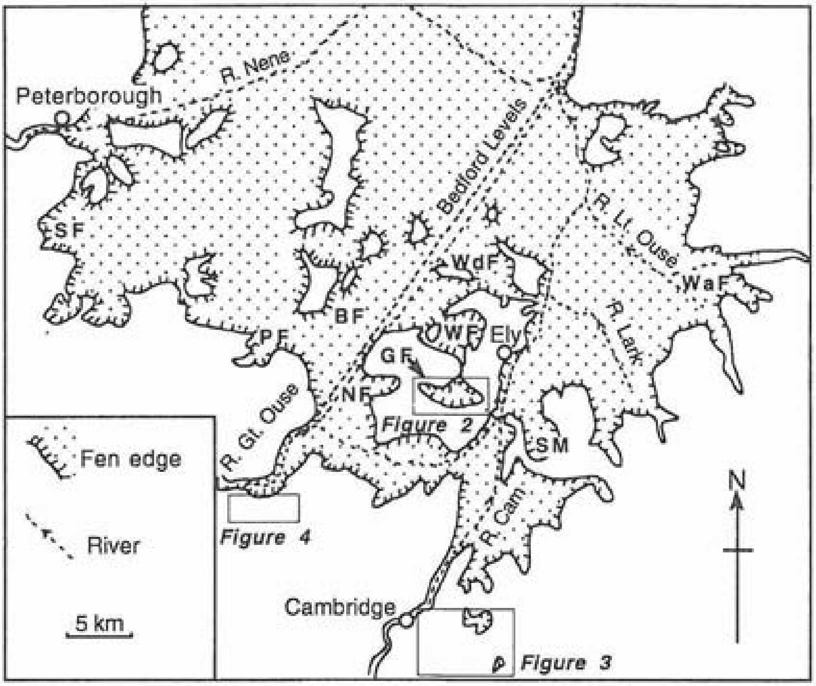

Figure 1: Map of southern fenland (after West, 1991) showing the fen edge and the courses of main rivers. The embayments referred to in the text are shown by the following abbreviations: BF = Block Fen, GF = Grunty Fen, NF = North Fen, PF = Pidley Fen, SF = Stilton Fen, SM = Soham Mere, WF = West Fen, WaF = Wangford Fen, WdF = Wood Fen. The location of the areas dealt with in detail (Figures 2–4) is shown by boxes.

Small hollows near Whittlesford (TL 464495), less than 100 m across, were attributed to thermokarst by Taylor (1978). However, it seems likely that such small features are the product of icings, also known as naleds or aufeis, which are an accumulation of surface ice, often fed by springs (Muller, 1947; Coxon, 1978). Many of the features described by Burton (1976, 1987) from the western margin of the Fenland in Stilton Fen (Figure 1) are near-circular depressions about 1 km across. West (1991) also recognised similar features, for example at Chettisham (540834). However, Burton (1987) identified a much larger thermokarst depression in Block Fen at Mepal (440380), and West (1991) described a series of large embayments along the Fenland edge at Grunty Fen, Wangford Fen, Soham Mere, Pidley Fen, Wood Fen, West Fen and North Fen (Figure 1). Many of the embayments contain deposits derived from solifluction associated with backwearing processes. An example is the Crowland Bed, described from embayments by Booth (1982) and Gozzard (1982). It is a variable grey silty clay, sometimes with sand or pebbles, which overlies bedrock or Devensian gravels, but is covered by the earliest Flandrian peat. Consequently, it is possible to date the most recent period of backwearing in these features to the Late Devensian.

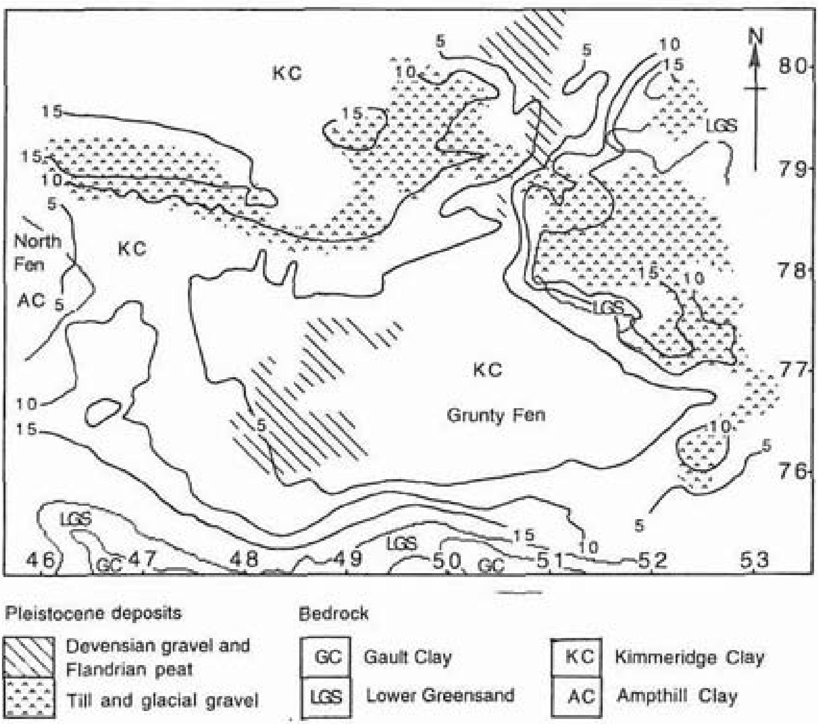

Figure 2: Map of Grunty Fen showing the geology and contours at 5-m intervals. Geology reproduced by permission of the Director, British Geological Survey. NERC copyright reserved. Contours reproduced from Ordnance Survey 1:25 000 scale Pathfinder maps with the permission of the Controller of Her Majesty's Stationery Office, © Crown copyright.

Grunty Fen

West (1991) demonstrated the thermokarstic development of a large embayment on Kimmeridge Clay at Grunty Fen (Figure 2). It is an impressive feature some 5 km long and 2 km wide, bordered by rounded hills which rise to more than 15 m O.D. and comprise an outcrop of Lower Greensand to the south and a discontinuous sheet of till (boulder clay) overlying bedrock to the north. Grunty Fen displays many attributes of thermokarst, as described by West (1991). The floor of the embayment at 2–3 m O.D. exhibits very low slope angles of less than 1° and is partly occupied by Flandrian peat and partly by gravels of probable Late Devensian age. The feature has a narrow outflow channel to the north and is elongated east–west, with a low col at the western end joining it to North Fen. This embayment appears to have developed independently of the Cam and Great Ouse river systems.

South-east Cambridge

In the area south-east of Cambridge, a complex of thermokarst landforms occurs on Lower Chalk between the outcrop of the Totternhoe Stone at about 15 m O.D. near the foot of the Chalk escarpment to the south and low rounded hills composed of Pleistocene (pre-Devensian) gravels to the north (Figure 3). Feature a is a circular depression about 1.5 km in diameter, with a floor at 9 m O.D. and a narrow outlet channel draining north. A significant proportion of southern Cambridge has been built in this depression: it might surprise residents to learn that their gardens were once part of a thaw lake! The outlet of feature a leads to Coldham's Common at 8–9 m O.D., which occupies much of feature b and in turn drains north through a narrow outlet to the River Cam. Feature c is a channel also at about 9 m O.D. which runs eastward across Cambridge Airport towards Teversham Fen and connects feature b with the large embayment of Little Wilbraham Fen (d) to the east. The floor of Little Wilbraham Fen is at 8–9 m O.D. and is occupied by Flandrian peat and Late Devensian gravels. There is a narrow outlet channel at Quy Mill which drains to the north. Feature d extends south to join with a slightly more elevated (11–12 m O.D.) depression (e) east of Fulbourn village. This area also contains various Flandrian and Devensian deposits and, taken with d, forms an embayment some 5 km long and 2 km wide. To the west of feature d and connected to it by a narrow channel there is another circular depression (f), again at about 9 m O.D., which is occupied by Caudle Ditch. This complex of features has evolved independently of the River Cam and seems to represent the range of depressions, embayments and channels that West (1991) envisaged developing through prolonged thermokarst activity.

Swavesey

Near Swavesey there are two depressions on Ampthill Clay (Figure 4). Cow Fen occupies feature a and is bounded to the north-east by low hills reaching 18 m O.D. and capped by till and glacial gravel. To the east there are Pleistocene (pre-Devensian) gravels at about 8 m O.D., and to the south and west there are areas of Ampthill Clay at a similar elevation. The depression is about 1.5 km in diameter, with a floor at about 4 m O.D. containing Flandrian alluvium. A narrow outflow channel leads to the north, and directly adjacent to this there is a patch of gravel presumed to be of Late Devensian age.

Feature b is bounded to the north and west by Pleistocene (pre-Devensian) gravels at about 10 m O.D. and to the south and east by Ampthill Clay at a similar altitude. This depression contains Late Devensian gravel and Flandrian alluvium and has a floor at 6–7 m O.D. with a narrow outflow channel leading to the north. Consequently it is not well defined by the 5-m contour interval of the O.S. map (see Figure 4). It appears that these two depressions have formed separately from the River Great Ouse system.

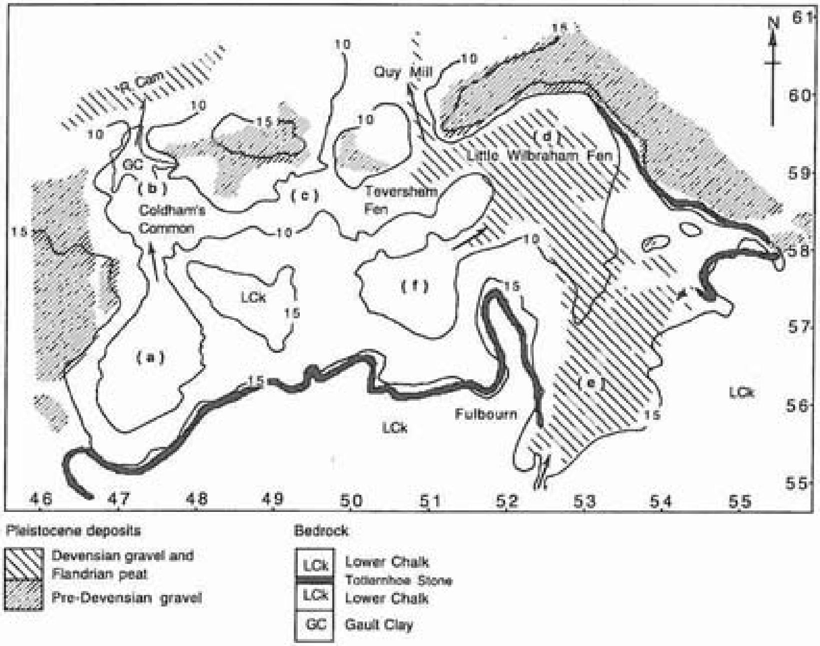

Figure 3: Map of the area south-east of Cambridge showing the geology and contours at 5-m intervals. Geology reproduced by permission of the Director, British Geological Survey. NERC copyright reserved. Contours reproduced from Ordnance Survey 1:25 000 scale Pathfinder maps with the permission of the Controller of Her Majesty's Stationery Office, © Crown copyright.

Other locations of interest

Further potential examples of thermokarst landforms are relatively easy to find in the Cambridge area. Returning to south-east Cambridge, at the foot of the Gog Magog Hills (475545) on Lower Chalk one can see an embayment defined by the 20-m contour and confined to the south by the outcrop of Melbourn Rock. This depression is close to, but rather higher than, the complex of thermokarst features shown in Figure 3. It is possible that this embayment is a relict feature dating from a pre-Devensian cold stage.

At Little Shelford (453505) there is a depression with a floor at about 14 m

O.D. about 1 km in diameter on Lower Chalk. It is confined by the outcrop of Melbourn Rock to the south and west at about 25 m O.D. and by a patch of Pleistocene (pre-Devensian) gravel at a slightly lower elevation to the east. The depression has a narrow outlet channel which drains north-east to the valley of the River Cam.

A little further to the south, associated with the outcrop of Melbourn Rock, there is a series of hollows at about 22 m O.D. in the Lower Chalk stretching from Sawston (500488), through Whittlesford (465480) and Thriplow (440467), to Fowlmere (405455). These features are not generally confined by Pleistocene deposits, but most exhibit flat-bottomed shallow depressions with constricted outflows. It may be argued that these are simply the product of headward erosion by springs issuing from the Melbourn Rock. However, a spring-fed water body similar to that found today at Fowlmere Watercress Beds (now an RSPB reserve) would, under periglacial conditions, have resulted in the rapid formation of a depression through thermokarst and similar processes.

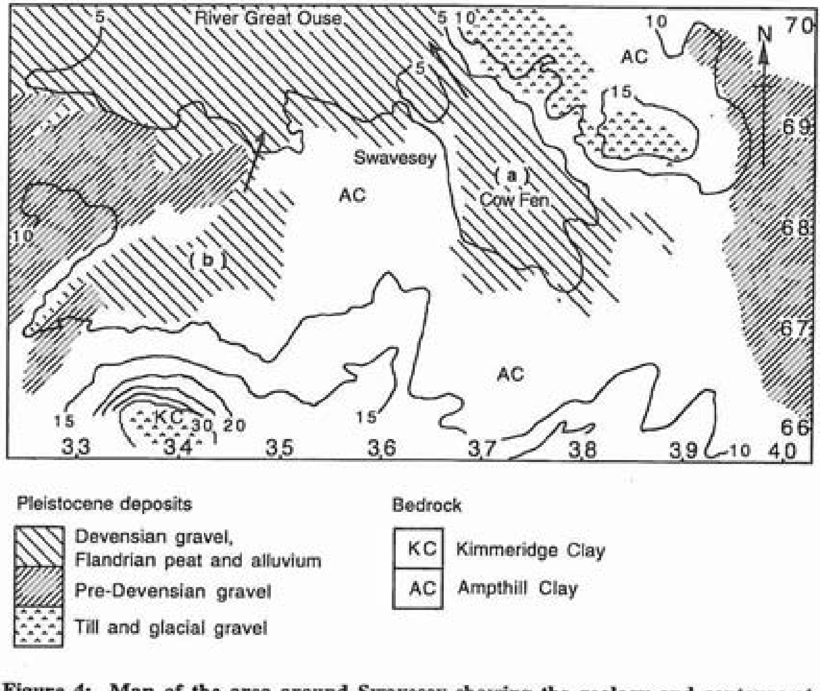

Figure 4: Map of the area around Swavesey showing the geology and contours at 5-m intervals. Geology reproduced by permission of the Director, British Geological Survey. NERC copyright reserved. Contours reproduced from Ordnance Survey 1:25 000 scale Pathfinder maps with the permission of the Controller of Her Majesty's Stationery Office, © Crown copyright.

Conclusions

A variety of thermokarst landforms have been recognised from the area around Cambridge. These range from near-circular depressions about 1 km in diameter to embayments more than 5 km long. It seems that thermokarst and other periglacial features are relatively widespread in Cambridgeshire and that they have had a significant impact on the landscape. Although these landforms have developed on a variety of different clay- or silt-rich bedrock types, it is clear that they are mostly confined by outcrops of Pleistocene deposits and resistant bedrock lithology. It is possible that some thermokarst features have a polycyclic origin, having been repeatedly activated in past cold stages. In contrast, others are more clearly the result of Devensian periglacial conditions. In either case, one must imagine the Cambridge area dominated by a braided River Cam, flowing through a bleak, treeless tundra landscape, pockmarked by hollows, channels and embayments containing thaw lakes.

Acknowledgment

I should like to express my sincere thanks to Professor R.G. West for the invaluable discussions, help and encouragement received during the gestation of this project.

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The Scholars' or Pagoda Tree *Sophora japonica* on the Downing Site, Cambridge

S.M. Walters

To celebrate the centenary of the Cambridge Natural History Society in 1957, a specimen tree of *Sophora japonica* was planted in the middle of the lawn between the Department of Plant Sciences and the Museum of Archaeology and Anthropology. I was present as a Council member of the Society for the planting ceremony, which took place on a cold, wet December morning. Professor Sir Vincent Wigglesworth, as President for that year, performed the ceremony, and the Society placed a permanent metal notice at the base of the tree recording the event.

The choice of *Sophora*, an unusual tree from the Far East sometimes called in Britain the Scholars' or Pagoda Tree, was deliberate. When the old Botanic Garden was on the site now occupied by the Zoology Department, it contained a specimen, which reached a ripe old age before it finally fell victim to progress and was felled to build the present Zoology buildings in 1932. An old photograph of this tree exists and was published in Humphrey Gilbert-Carter's *Guide to the University Botanic Garden* (ed. 2, 1947).

There were therefore two good reasons for selecting a *Sophora*: the tree had interesting historic associations with the development of biological sciences in Cambridge and it was known to be quite long-lived in Cambridge City.

In May 1992, the Director of Estate Management in the University applied for planning permission to fell the Pagoda Tree as part of the preparations to build the McDonald Institute of Archaeological Research. There was a public outcry when this became known, and a protest meeting took place round the tree on Friday, 19 June. More than 100 senior and junior members of the University joined hands and danced round the threatened tree; the protest reached the national press and regional television. Wiser counsels prevailed in the University, the application was withdrawn and the tree was saved.

With the completion and opening of the McDonald Institute on the site, we can now admire the Natural History Society's tree free from protective hoardings. To reward those who showed their concern and saved the tree, it has flowered, albeit sparingly, in two of the summers since the threat was removed, notably first immediately in August 1992 and again in 1995. It is characteristic of this species in cultivation in Britain to be slow to come to maturity and flower: 30 years from the seedling stage seems to be the minimum requirement. Another factor affecting the flowering is obviously climate. *Sophora* does best in a more continental climate than even East Anglia supplies, flowering regularly and profusely in central France, for example.

Die-back of some branches, which the tree was showing rather obviously in 1990 and 1991, is quite characteristic of *Sophora* as grown in Britain and should not be interpreted as the onset of serious disease or death. Our tree was sensibly pruned to remove dead branches and to shape it to fit the site during last winter, and we can reasonably expect a long life ahead. With any luck, generations of students will be able to sit around and under its light feathery shade every summer for the next century.

It is tempting to suppose that the generic name of the Scholars' Tree derives from the Greek work *sophos*, wise. The experts, however, tell us that *Sophora* comes from the Arabic name for the tree (or some other related tree) meaning yellowish and referring to the creamy-white flowers. It does, however, seem to be true that the tree is associated in China with the instruction of scholars under its shade. So the whole thing seems to be an odd coincidence!

Swamp Stonecrop *Crassula helmsii* in Cambridgeshire

S.M. Walters

Introduction

It is now 15 years since Erica Swale and Hilary Belcher recorded the first naturalised colony of the invasive alien aquatic *Crassula helmsii* in Cambridgeshire (Swale & Belcher, 1982). This excellent, beautifully illustrated paper concludes as follows: "Many artificial water-bodies are at present being made both for amenity and to encourage wildlife. The edges of such pools may remain bare and unattractive for some time, especially where polythene has been used in the construction. Here is an excellent ecological niche for *Crassula helmsii*, which grows rapidly to form an attractive and seemingly desirable addition to our flora."

Few botanists would hold this view today. Indeed, this invasive plant from the Antipodes now gets the 'alien devil' treatment in the national press previously used for notorious invaders such as Giant Hogweed *Heracleum mantegazzianum*. (See, for example, *The Times* of 19 February 1996, "Botanists seek legal ban to tame wild rover", and *The Independent*, 21 February 1996, "Botanists warn of 'creeping death'".)

My own acquaintance with *Crassula helmsii* goes back to 1980, when I first saw it growing in the formal ornamental pond at Highsett, Cambridge. More recently my attention has become focussed once more on the plant because of its behaviour in two recently constructed ponds in 'nature areas' attached to Primary Schools, and this note arises from my observations and enquiries.

Identification

When growing vigorously in a shallow pond, *Crassula helmsii* can form a very dense, bright green moss-like blanket completely covering the water surface. The individual thin shoots bear opposite pairs of narrow, rather fleshy leaves which are joined at the base to make a small 'collar' round the stem node. The length of the internodes can vary greatly, as can the habit of growth and the fleshiness of the leaves. It can be confused in the submerged state with *Callitriche* spp. (water-starworts), but the 'collar' at the leaf-base (absent in *Callitriche*) is a certain mark of identity. Flowering takes place freely on emergent shoots, but the flowers are small and easily overlooked.

Ecological observations

In both Barton School and Newnham Croft School, where I have been to some extent involved in the construction of small 'nature areas', the shallow ponds constructed with heavy-duty polythene showed impressive carpets of *Crassula* at the end of the hot summer of 1996. This was obviously encouraged by the drying-out of the ponds; it is clear that pond margins or shallow water produce ideal conditions for the growth of *Crassula*, which effectively seals off the water surface and can kill a whole range of competitors. It is, of course, precisely the effect of this competition on rare native plants (such as *Galium constrictum* and *Illecebrum verticillatum* on pond margins in the New Forest, Hampshire) that has caused the concern of botanists.

At the Newnham Croft school pond, which I visited on 21 January 1996 together with my granddaughter Lucy, a pupil at the school, we found a very dense carpet of *Crassula helmsii* over about one third of the area of the pond, with marginal stands around the plastic-covered 'lip'. These areas were dark brown and apparently dead, but scattered over them were small green terminal shoots easily detached, which I took at the time to be seedlings but later concluded were vegetative fragments, already rooted, such as are described as 'turions' by Dawson (1994). No seedlings have yet been recorded in Britain and, according to Dawson, no one has succeeded in germinating seeds taken from flowering British plants. Here is a problem that any keen naturalist might follow up: is the spread of *Crassula helmsii* entirely by vegetative means, or is seed also involved?

Spread in Cambridgeshire (v.c. 29)

Judging from the relatively few records at the Biological Records Centre at Monks Wood, the spread of *Crassula* is slower in this vice-county than, say, in Surrey or Hampshire (see Figure 1). We have at present only 13 records from five 10-km squares, which seems unlikely to be an adequate picture of the present distribution. One obvious difficulty – which applies especially to aquatic and marsh plants – is that owners of garden ponds or ornamental ponds in private grounds do not often record 'wild' plants in such a way that they are available to the BSBI Recorder and the Biological Records Centre. Once again, we see that monitoring of spreading species, whilst often crucially important in planning management of wild habitats, is somewhat haphazard and inadequate. In the case of *Crassula*, we should surely encourage all pond owners (including those who, having introduced this aggressive aquatic into their ponds in the first place, are now regretting it!) to notify the Biological Records Centre that they have (or have had) the plant 'in cultivation'.

Acknowledgements

I am most grateful to my colleague Chris Preston for lending me his extensive file on *Crassula helmsii*, for a list of records of the plant in v.c. 29 and for the up-to-date national distribution map.

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Editor's note: In the figure in this last paper the captions to drawings **A**, **B** and **C** should refer to **D**, **E** and **F** respectively, and vice versa. The references to these drawings in the text are correct.

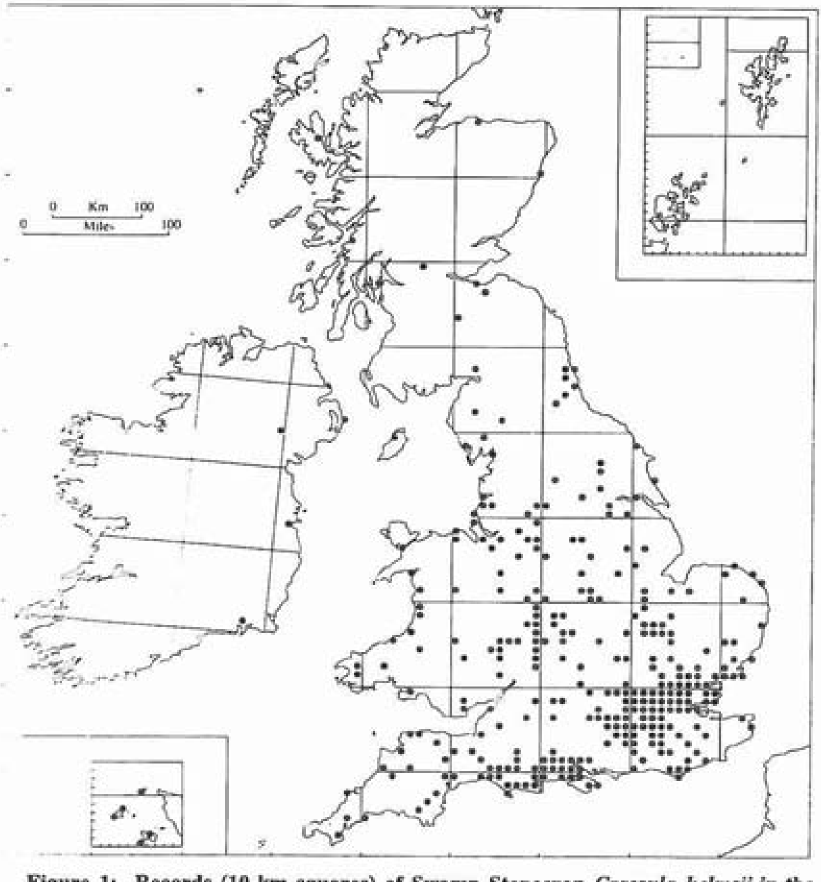


Figure 1: Records (10-km squares) of Swamp Stonecrop *Crassula helmsii* in the British Isles up to February 1996 **Biological Records Centre, ITE**

Madingley Wood

Oliver Rackham & David E. Coombe

Madingley Wood (41.5 acres = 16.8 ha; grid reference TL 3959, 4059; altitude 120–202 ft = 37–62 m) is the nearest ancient wood to Cambridge. It is the Cambridge equivalent of Wytham Woods near Oxford, the scene of countless investigations by generations of ecologists. The University acquired it, with the rest of the Madingley Estate, in 1948. This article is not so much concerned with the research as with the wood itself as a living object. D.E.C. has known the wood for 46 years and O.R. for 35 years. Our predecessors have frequented the wood for 340 years, giving Madingley one of the longest botanical records of any wood in Europe.

According to the canons of place-name interpretation, Madingley in the Anglo-Saxon period should have been an open space (Old English *leah*) in a wooded landscape, wherein the henchmen of Mr Mad set up their dwellings. The wooded landscape – whether it was wildwood or post-Roman secondary woodland – was soon converted to wall-to-wall arable land in which, for some reason, an island of woodland was left. This appears to have been already so by Domesday Book, which records Madingley as having "grove for fences", the usual way in which Domesday Book records small woods in west Cambridgeshire.

Madingley in the middle ages had all the buildings (save one outlying farm) concentrated in a village by the church and a modest manor-house. The rest of the land was divided into thousands of half-acre strips, represented in the modern landscape by curving ridge-and-furrow. There were several manors and sub-manors and an exceedingly complex pattern of ownership. As at Gamlingay[1] (but not as at Hayley Wood[2]), the strips came almost up to the wood and were separated by a narrow headland on which to turn the plough. The wood belonged to the lord of one of the manors.

Thus far Madingley followed the usual history of open-field villages. It diverged in the 1520s, when the Hynde family began to buy up land, to build a magnificent Hall, to begin a park and to become resident squires. They and their successors the Cottons enlarged the park and moved the village to a different site. By about 1808 the Cottons had become owners of the whole of Madingley. Without needing to get an Enclosure Act, they abolished the open-fields shortly after. Madingley Park today is a remarkable relict landscape preserving several generations of park design on top of a deserted village and its fields.[3] The park never reached far enough to include the wood.

History of Madingley Wood

Of the wood in the middle ages we know little. It may be the "grove regularly felled" mentioned in 1347 in a survey of Madingley after the lord of the manor's death.[4] The open-field of Whitwell hamlet, lying across the road to the south,[5] was known as Wood Field, and since Whitwell had no wood this presumably refers to Madingley Wood adjacent (Figure 2). Wood Field appears in documents from about 1210 onwards. Madingley also had a Wood

Field adjoining the wood, but this name seems not to be recorded before 1600.

We hear more of the wood in 1612 from a kind of leaseback agreement. Sir William Hynde, dying in 1605, had bequeathed the estate to his widow, who had married again and was now leasing Madingley for 21 years to her brother-in-law, the new squire. The premises included the Hall, the Park and adjacent pastures, and

> . . . one Woode grownde called Maddingley Woode . . .. The saied Edward Hynde . . . vpon eny fall of Tymber or woode to be made in and vppon the above demised premisses [shall] fence in and inclose the same woode groundes soe felled wth sufficient fencs, and keepe & preserve the younge sproughte and springe of the same woode groundes, from biteing of Cattell or any other spoyle or destruction accordinge to the lawes and statudes of this Relme in that behalfe made and provided.[6]

Madingley, like almost all Cambridgeshire woods, was therefore a coppice-wood with scattered timber trees, producing "woode" from the coppice stools and "Tymber" from the standard trees. The lease is drawn up in the usual form, laying upon the lessee the duty of fencing animals out of the wood after felling, lest they bite the new shoots arising from the stools. A rare feature of this lease is the allusion to the Statute of Woods, 1543, which provided (among other things) that woods adjacent to common-land "shalbe sufficientlie enclosed and fenced . . . by the Space of Seaven Yeres next after everie fellinge thereof".[7] It is most unusual to find evidence that anyone knew about this Act.

More than half the wood was grubbed out, probably in the 17th century (Figure 4c). Nineteenth-century maps depict four fields, each of 4–5 acres, as clearings within the eastern half of the wood. They were called wood-closes. As we shall see, field evidence indicates that the original clearing was more extensive than the maps reveal. Only the western third of the present wood appears to be medieval; the strips of wood around and between the fields are secondary woodland.

Soon after the grubbing-out the wood-closes began to revert to woodland. The hedges around the four fields, which were partly of elm, began to expand. Most of the strips of woodland are shown on an estate map of 1811 (Figure 4d)[8]; all of them are there on the Madingley tithe map of 1849.[9]

The Cottons then began planting trees. The Ordnance Survey 25-inch map, surveyed in 1886, shows the S.W. field (D1, Figure 3) full of conifers, surrounded by strips of ordinary woodland. The remaining three were still fields. A few conifer symbols represent conifers planted into the old wood; their annual rings indicate planting in the 1870s. The next edition of the O.S., surveyed 1901, has conifers in the S.E. field (D4), what appears to be a deciduous plantation (an unusual kind of tree symbol) in the N.W. field (D2), and a mixture of ordinary woodland and conifers in the N.E. field (D3). The third edition, 1924, gives the same information but with ordinary woodland symbols gaining on the conifers. This last change is usual for small plantations attached to existing woods; the planted trees were evidently allowed to get overtaken by native trees.

Table 1: History of the various compartments of Madingley Wood

	1811	*1849*	*1886*	*1901*	*1924*	*1995*
Old wood A1, A2, A3	wood	wood	wood	wood	wood	wood
Wood B1, B2	wood	wood	wood	wood	wood	wood
Belts C1 to C7	wood	wood	wood	wood	wood	wood
Belts C8, C9	field	wood	wood	wood	wood	wood
Belt C1a	field	field	wood or plantation	wood or neglected plantation	wood	wood
Field D1	field	field	conifer plantation	conifer plantation	neglected plantation	wood
Field D2	field	field	field	ash plantation	neglected plantation	wood
Field D3	field	field	field	ash + conifer plantation	neglected plantation	wood
Field D4	field	field	field	conifer plantation	neglected plantation	recent neglected plantation
Chalkpit E1	pit	pit	neglected conifer plantation	neglected conifer plantation	neglected conifer plantation	poplar plantation
Panhandle E2	field	field	field	conifer plantation	conifer plantation	sycamore plantation
Corners F1, F2	field corner		wood	wood	wood	wood with signs of planting
Corner F3	field	field corner	field corner	field corner	"scrub"	wood

The 'Panhandle' at the north end of the wood originated as a field with a big chalk-pit in it. The pit, already there in 1811, is shown as a neglected plantation in 1886. The field later became a neglected plantation.

A notice appeared in the *Cambridge Chronicle* of 11 February 1882, advertising

> sale of 20 Ringes of Capital Underwood and a large quantity of Oak and Ash Leg and Topwood . . . in [Madingley] Wood.

A similar notice was for "Topwood and Underwood" on 22 March 1901. Such advertisements commonly appear, at irregular intervals, for Cambridgeshire woods. Part of the wood had evidently been felled, yielding underwood from the coppice stools. "Leg and Topwood" represent the branches of timber trees cut down at the same time; the timber parts of the trees had been disposed of separately and do not appear in the advertisement. Twenty ringes – two or two and a half acres – would represent about one-eighth or one-tenth of the coppiceable area of the wood at the time.[10]

A celebrated visitor was Richard St Barbe Baker, founder of Men of the Trees, who did research at Cambridge University Forestry School in about 1925 and stayed at the Hall. He "had the opportunity of practising forestry in the woods of the Madingley Hall Estate".[11] He could be responsible for some of the older sycamores and poplars now in the Panhandle.

In the late 1940s the east end of the wood was chopped off and became part of the American Military Cemetery; little now remains of it except some of the trees. The Madingley Estate became the property of Cambridge University. The wood was set aside as a research area. It received little management apart from maintaining the rides. Areas C9 and D4 were felled in 1983/84 and an attempt was made at replanting them. Parts of the old wood were coppiced from 1990 to 1994 after a felling of oaks.

Earthworks

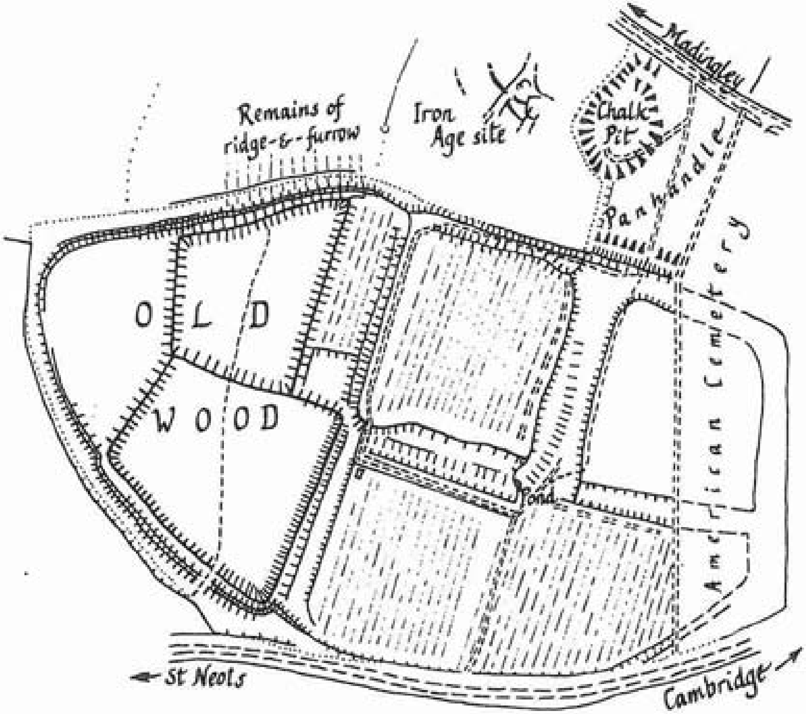
The earthworks (Figure 1) are nearly unique for woodland. The most prominent are two massive quadrilateral banks and ditches within the old wood. A third quadrilateral appears to surround the N.W. wood-close (D2). These are more massive than an ordinary woodbank, though similar in profile; sometimes the bank is on the outside of the ditch, sometimes on the inside, sometimes on both sides.

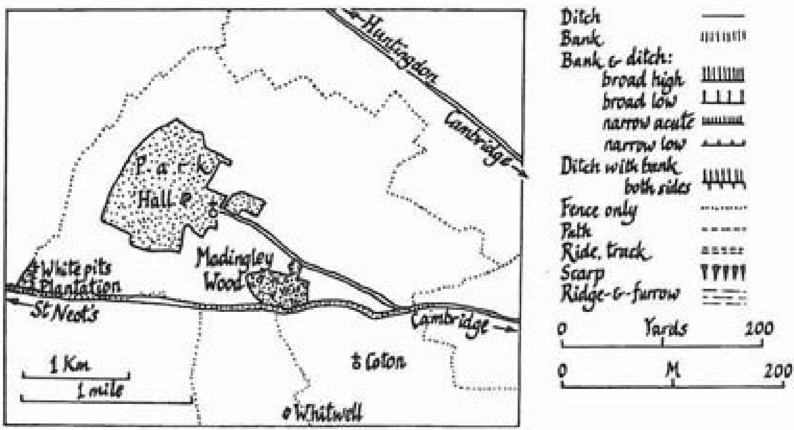
Surrounding the whole wood (except where destroyed by road-widening) is another earthwork. In places a typical woodbank, with an external ditch, can be detected, but often the earthwork has three parallel ditches and internal as well as external banks. This probably comes from interaction between the woodbank and the surrounding open-fields. As is well known, soil tends to accumulate on headlands where the plough is turned. The wood, moreover, tends to encroach on the field, especially if, like much of Madingley, it is composed of elms which sucker. The successive ditches, some of them dug into either the woodbank or the headland ridge, probably represent attempts to define the edge of the encroaching wood. This is most clearly seen on the north side, where the wood has overrun both the headland ridge and the ends of the strips. The strips have been effaced by modern ploughing in the adjacent field, but short lengths of them survive as ridge-and-furrow inside the wood.[12]

The wood-closes are largely surrounded by lesser earthworks, probably made in the 18th or early 19th century. Three of the four contain traces of ridge-and-furrow, which is not of the medieval type. The ridges are narrow and straight, unlike the broad, curved ridges of medieval ploughland (Table 2). They do not extend into the strips of woodland and are thus probably early 19th-century; they were a despairing attempt to make this heavy land cultivable. (Since area B1 was already woodland in 1811, the ridges in it were presumably of earlier post-medieval date.)

Table 2: Wavelength of ridge-and-furrow

Typical medieval	10.0 m
Medieval, cut off on north edge of Madingley Wood	8.8 m
17th-century in Hayley Wood Triangle	8.6 m
Post-medieval, wood-closes inside Madingley Wood	7.0 m





Figures 1 and 2: Earthworks of Madingley Wood and location map

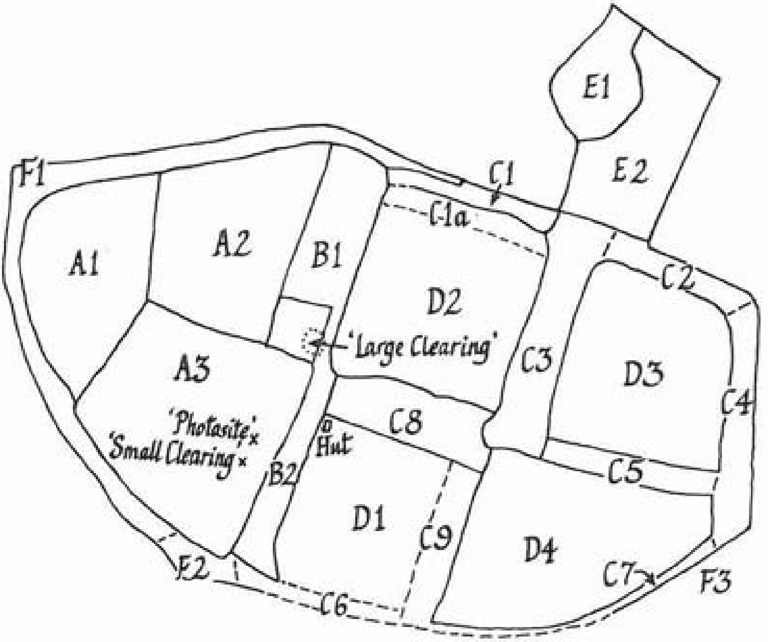


Figure 3: Topography of Madingley Wood, showing the compartments (A1, etc.) referred to in this paper and the sites of observations and experiments ('Large Clearing', 'Small Clearing' and 'Photosite')

What are the three quadrilaterals?

The earthworks around A2, A3, and B1 + D2 (Figure 3) are the earliest feature; they came before the woodbank, which was fitted round them. There may have been other compartments destroyed or altered by the making of the other three fields. What is the explanation? There are normally four reasons for banks and ditches in the interior of a wood:[13]

1. The wood has grown bigger – for example Hayley Wood on its N.E. side – and the internal bank marks the former edge.
2. The wood was divided among owners – for example Gamlingay Wood between about 1200 and 1601 or, on a larger scale, Eversden Wood.[14]
3. The wood once formed part of a wood-pasture (for example a deer-park). The banks mark compartments, each of which was felled in turn and then fenced to exclude the livestock until the young shoots had grown up – for example Monks' Park in the Bradfield Woods, West Suffolk.
4. The wood incorporates some feature which was there before it became a wood – for example Overhall Manor earthworks in Overhall Grove.

Here it would be difficult to reconstruct a scheme whereby each of the internal earthworks was successively the boundary of an enlarging Madingley Wood. Ownership divisions are possible, given the fragmented medieval ownership of Madingley parish, but these banks are different in character from known ownership banks and do not join up properly with the perimeter bank.

The deer-park theory has commended itself to generations of Cambridge archaeologists, but it is supported only by an unverified mention of a "great park" somewhere in Madingley in 1232.[15] The present wood, it is true, has the compact outline of an early park; but it would be surprising to find an area of only 42 acres (one-sixth the size of the average deer-park) described as a "great park". Known compartment-banks in parks, unlike those here, resemble miniature woodbanks, more sinuous and much less massive than these, and join up with the perimeter earthwork.

A more likely explanation is that the three quadrilaterals are an Iron Age feature. This has very recently been corroborated by the discovery and partial excavation of a settlement site only 120 m away in the field west of the chalk-pit. Finds extend into the pit itself. The evidence consists of remains of several intersecting ditched enclosures (indicating a long-lived settlement going through many alterations), pottery, tile and coins. These are "suggestive of a Late Iron Age to fourth-century A.D. farmstead, probably becoming Romanised during the second half of the second century".[16]

Madingley Wood thus has earthworks, unexplained in terms of the wood's history, directly adjacent to a known Iron Age site. In all probability these are either an outlying part of this site or an earlier phase in its development. They would be comparable to the 'field-system' attached to Portingbury Rings, an apparently Iron Age site in Hatfield Forest (Essex); these earthworks are likewise irregularly rectangular and of similar dimensions.[17] (Somewhat similar, massively ditched enclosures occur in Westhall Wood, Rickinghall Inferior, Suffolk.) Their original function may have had something to do with Madingley Hill being a very good viewpoint. After the Iron Age – possibly while the lower part of the site was still occupied – they became woodland and were surrounded by woodbanks. The farmstead site, less strongly ditched, was abandoned and effaced and disappeared under the ridge-and-furrow of Wood Field.

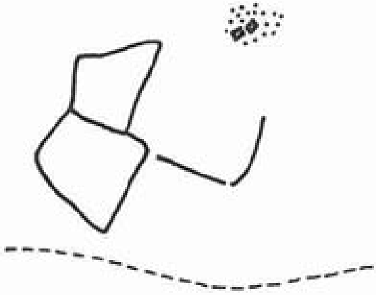
These pre-existing features, too substantial to be effaced, determined the location of the medieval Madingley Wood here, rather than somewhere else in the parish. (They may even have been reused as compartment boundaries within the medieval park, if it was located here.) Just as small woods, isolated in the modern landscape, often have abandoned medieval moats inside them, so Madingley Wood, islanded among the medieval open-fields, was based on an abandoned prehistoric feature.

Other woods in which some of the earthworks appear to be pre-medieval include Gamlingay Wood[18], Overhall Grove and Waresley Wood. The fact that a wood is now Ancient Woodland does not prevent it from being the scene of prehistoric activity.

Vegetation

Trees and soils

Madingley Wood, like most of the ancient woods on the west



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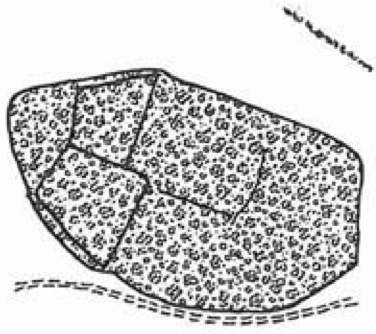

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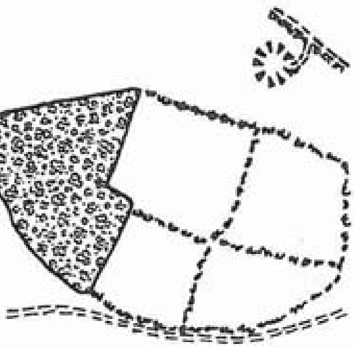

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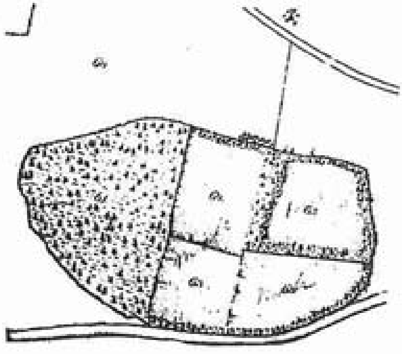

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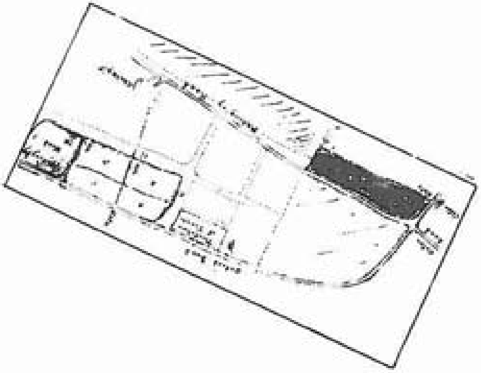

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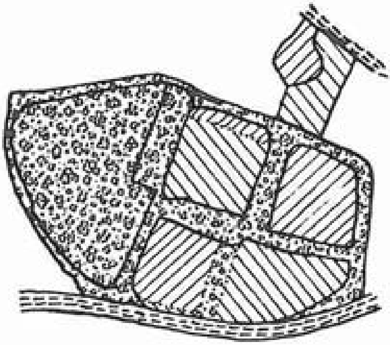

f

Cambridgeshire boulder clay, is an ash–maple–hazel wood with standard oaks and with a strong tendency to be invaded by elm.[19] This is best developed in the old wood (A and B), about one-third of which is elmwood, the remainder varying from maple-dominated to hazel-dominated areas. The big oaks are of various dates in the early 19th century. The wood is a coppice, though probably not cut for over a century; some of the maple stools are of great size and centuries old. A few conifers survive from an attempted planting in the 1870s. The Cottons also disguised the wood from the outside by a fringe of fashionable trees – beech, horse-chestnut, box – some of which survive along the road frontage. Gamekeepers' plants, such as Snowberry *Symphoricarpos albus* (*S. rivularis*), are also relics of this period.

Soil samples from 15 cm depth show a high clay content (40–52% by weight), an appreciable silt content (15–31%) and a low sand content (10–14%). The pH varies from 5.2 to 6.5 on a scale of woodland pH from 3.0 (the most acid) to 7.8 (the most alkaline). Madingley Wood thus has similar soils to Hayley Wood, but it is better drained. The soils are derived mainly from boulder clay, with some input of windblown dust (loess).[20] Madingley does not have the very wet areas of Hayley Wood nor the acid sand-lenses of Gamlingay Wood or Weston Colville Lower Wood.[21] In Soil Survey terms this wood is a typical example of the Hanslope Soil Series; pits dug by the Survey's investigators are still visible.

The fringe areas (B) are very similar to the old wood. Ridge-and-furrow (of the post-medieval type) shows that they have been cultivated at one time, though in the more distant past than areas C or D.

The belts (C) approximate to natural woodland, dominated by ash and maple, with occasional great oaks, some of them older than those in the old wood. There are, as expected, no old stools. A striking feature is the near-absence of hazel, whose place is taken by an understorey of hawthorn and blackthorn.

The wood-closes (D) all passed through a plantation stage, followed by neglect. Where the planted trees were conifers, only a few spruce and larch survive. The other conifers were probably felled, and the stumps have died and mostly rotted away (forming, meanwhile, a substrate for *Aulacomnium androgynum*, a once uncommon moss). All four closes were then occupied by tall, closely-set, pole-sized ashes. The ashes in D1 and D4 may have arisen naturally in succession to the conifers. Those in D2 and D3 are probably the first generation of trees on the site, because there is no sign of any

Figure 4 (opposite): Madingley Wood and its surroundings
(a) in the late Iron Age (distribution of woodland unknown);
(b) *c.* 1600, before grubbing-out of the eastern part;
(c) *c.* 1700, after grubbing-out of the eastern part;
(d) in 1811, surrounded by open-fields, from an estate map by W. Custance;
(e) in a sketch-map of the wood and surroundings (including Coton Copse to the east) in a notebook entitled 'Localities of Plants in Cambridgeshire observed by W.H. Coleman in 1833–34–35' in the Babington Papers, in the library of the Department of Plant Sciences, Cambridge (south-west being originally at the top);
(f) *c.* 1950, the hatched areas being plantations and ex-plantations of various dates

regrowth from previous ashes. They include the original planted trees: in the American Cemetery, and formerly in D2, ashes can be seen in rows which include surviving conifers. If original, they would be about a century old and very poorly grown, perhaps because they were of 'improved' stock from a commercial source not adapted to the environment of Madingley Wood. In all four old fields there is very little maple or hazel; blackthorn forms a sparse understorey. (In D2 anthills from the former pasture were still visible in 1966, having lasted two-thirds of a century.)

Ground vegetation

There are three major plant communities: (1) dominant Dog's Mercury *Mercurialis perennis*, sometimes with Bluebell *Hyacinthoides non-scripta*, indicating relatively well-drained calcareous woodland; (2) a combination of *Ajuga reptans*, *Poa trivialis*, *Glechoma hederacea*, *Arum maculatum*, *Rumex sanguineus*, *Ranunculus ficaria* subsp. *bulbilifer* and the moss *Eurhynchium swartzii*, a plant community characteristic of relatively fertile woodland; (3) dominant Common Nettle *Urtica dioica*, an indicator of high phosphate content, accompanied by *Galium aparine* and *Poa trivialis*. Elder *Sambucus nigra*, another fertility indicator, is common in the understorey. The picture is thus of clayey woodland, relatively well-drained and more fertile than most ancient woodland. Nettles are particularly abundant and vigorous in parts of the old fields (as relics of manuring) and around the ancient earthworks, where they are probably relics of some prehistoric activity that accumulated phosphate.

As in Hayley, Buff and other woods, nettle and especially mercury are highly competitive[22]; because of their abundance, plants such as Wood Anemone *Anemone nemorosa* and Common Spotted-orchid *Dactylorhiza fuchsii* are limited to spots where mercury and nettle are weak.

When we first knew the wood there was still a difference between the old and new parts, but *Mercurialis* has by now spread almost throughout, even into the chalk-pit. Nettles are more vigorous and abundant than in the 1950s, which indicates that the original phosphate has been supplemented from other sources. This is probably part of the general eutrophication of the landscape: the Woodpigeons *Columba palumbus* that roost in the wood drip phosphate, which also gets into the wood by fertiliser drifting from surrounding fields. Locally phosphate may have been released from the roots of dead elms.

Deer are a less significant factor in this wood than in others such as Hayley. Nevertheless Muntjac *Muntiacus reevesi* are resident and are suspected of browsing Goldilocks Buttercup *Ranunculus auricomus*. There have been occasional reports of Roe *Capreolus capreolus*.

The elms

Elms are a speciality of woods like Madingley. The south of the old wood (A3) is dominated by a very distinctive sort of elm – great rugged trees with rough bark and narrow leaves. These constitute a clone – a patch of hundreds of genetically identical elms all connected by a common root system. They arose from suckers from their predecessors' shallow roots advancing into the wood. This elm clone began as a single tree, at least 300 years ago, and has spread to occupy about five acres, displacing most of the former trees. The stems are of two ages, representing standard elms and underwood from the last coppicing. (Whenever a storm uproots an elm, new elms sprout from the exposed roots.)

This is the biggest of at least 21 elm clones in Madingley Wood (Figure 5). The others are clustered in the belts between wood-closes (areas C) and presumably began as hedgerow elms. They are more closely related to each other than the elms of Buff Wood, but less nearly identical than the clones of Overhall Grove.[23] Two clones appear to belong to the *Ulmus procera* (English Elm) group of elms, the other 19 to the *Ulmus minor* group (East Anglian Elms).

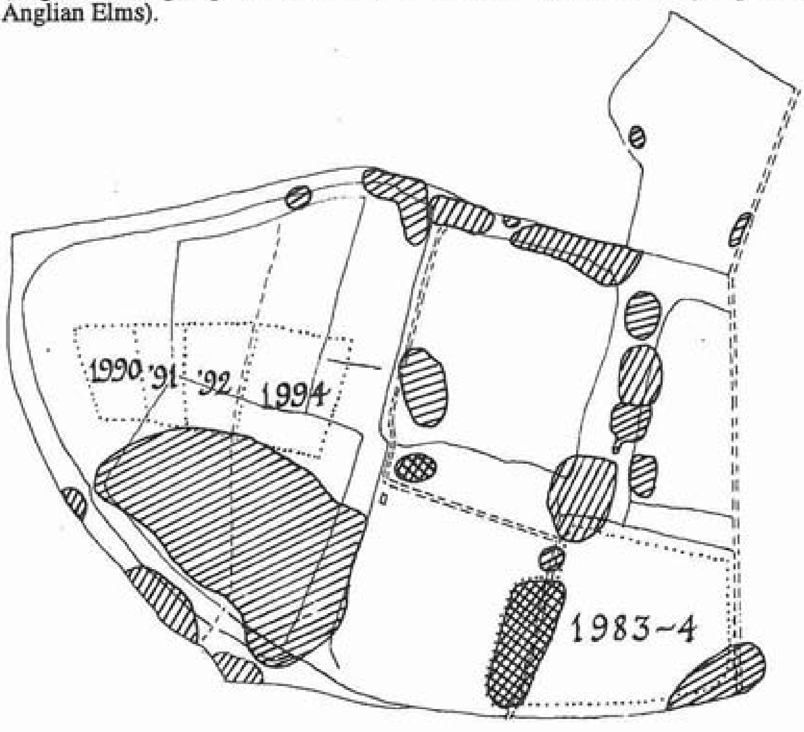

Figure 5: Elm clones of Madingley Wood and areas recently felled or coppiced (*Ulmus minor* single-hatched; *U. procera* double-hatched). The dates are the winter of felling.

The most recent epidemic of Dutch Elm Disease reached Madingley Wood in about 1974. As in other woodland elms, it spread slowly. By 1984 it had killed the big elms in most of the clones. The roots remain alive and have sprouted to produce often vigorous suckers; we doubt whether any of the 21 clones has been destroyed. (The scarcity of deer helps.) However, after 21 years of fighting Elm Disease, the biggest clone and its satellites remain largely intact. The disease is still present; trees have died here and there and the survivors have developed the curious twiggy growths in the crown (like multiple witches'-brooms) which result from repeated infection with Elm Disease; but most of the trees are alive.

'Sny' elms and hemispherical photography

In the five-acre elm clone most of the trees, some 25 m high, are neither straight nor crooked but grow in a regular curve, leaning from the base and bending over in a great arc. This gives the wood an American appearance. To most botanists in the eastern United States 'sny' trees (as they are called[24]) are too commonplace to call for an explanation: "Of course trees grow in this way – that's how they're made – d'you mean to tell me your trees in Britain don't grow in curves?" If pressed for an explanation, they sometimes mention the load of ice during a glazed frost.

The elms do not lean in any one direction; some of the ashes growing with them are sny too.

We know of fewer than a dozen areas of sny trees in all Europe, of which this is one. By good fortune it is where fixed-point photographs have been taken by us and our students and associates, notably M.C. ('Nan') Anderson, P. Freeman, and J.G.W. Hodge, since 1950.[25] The earliest is a hemispherical composite, made by fitting together many shots taken in different directions with a lens of 10.5 cm focal length. This has been followed by a succession of photographs with a fish-eye lens (invented by Robin Hill, the Cambridge biochemist) which projects a whole hemisphere onto a flat surface.

The story of most woods in this century has been of long decades of little change, interrupted by brief catastrophes due to felling, storms, Elm Disease, etc. The elm sites in Madingley Wood illustrate a period of stability. Elms have gradually encroached on the big oaks which form the standard trees. Oaks have been remarkably stable, even dead boughs lasting for over 45 years. An oak which in 1950 was long-dead, fallen and debarked has hardly altered since. Elms and hazels overshadowed by the canopy trees have changed surprisingly little. Maples, however, can die and rot away very suddenly; one suppressed maple was alive in 1983, but by 1986 not a trace of it remained.

Most of the big trees have noticeably increased in thickness, but not the oaks. (An oak to the north of the 'photosite' had a girth at breast height of 2.159 m in 1957 and 2.311 m in 1996. Its increment from 1957 to 1976 was equivalent to a mean annual ring-width of 0.67 mm; from 1976 to 1985, following the great drought, the mean ring-width fell to only 0.35 mm; from 1985 to 1995, despite further droughts, it rose to 0.85 mm.[26])

The elms were already sny in 1951, but have become even more sny since. Whatever the cause, it is not solely due to a one-off event like an ice-storm. Since it involves ashes as well as elms, the cause must be at least partly environmental, not wholly due to the genetic peculiarities that make every elm clone unique.

Flora

The total list of flowering plants and ferns seen since 1950 comes to about 185 species. Including all records since Ray's in 1660 brings this up to 224 (including 12 planted trees and shrubs and about 10 other 'non-native' species). Madingley is thus a rich wood for its size, comparable to Hayley and Gamlingay and not far short of the supremely rich Buff Wood. It is limited by lacking very waterlogged or acidic areas.

Until recently Madingley Wood was also limited by lack of felling and, in consequence, lack of those plants characteristic of coppiced areas. Within the last ten years the list has been lengthened by about 90 species recorded for the first time in newly felled areas. The most remarkable is Common Reed *Phagmites australis*, which grows in D4 after felling in 1983/84. We have never seen it associated with coppicing elsewhere.

The usual additions to the floras of woods through introduced species – e.g. American Willowherb *Epilobium ciliatum* (*E. adenocaulon*) and Rosebay Willowherb *Chamerion* (*Epilobium*) *angustifolium* – have come late to Madingley. Birch arrived in the 1960s but has still not made much headway.

An unusual addition is *Impatiens parviflora*, an exotic annual brought here as an experimental plant in 1950. Its adaptations to shade are one of the classics of plant physiological ecology. It competes well with mercury and has slowly spread from the experimental sites in A3 and B1. Other experimental plants included the grasses *Milium effusum* (still present after 30 years, but it has not spread) and *Hordelymus europaeus* (native in Cambridgeshire only in Knapwell Wood; it soon died out in Madingley).

Plants unaccountably absent include *Carex remota*. Some generally common woodland plants, such as Honeysuckle *Lonicera periclymenum*, Wild Strawberry *Fragaria vesca*, Barren Strawberry *Potentilla sterilis* and Black Bryony *Tamus communis* are unexpectedly rare at Madingley.

Oxlip

Madingley Wood was one of the two sites where Oxlip *Primula elatior* was first recorded in Britain. John Ray in 1660 reports:

> Primula veris elatior pallido flore . . .. *Great Cowslip or Oxslips. In Kingston and Madingley woods abundantly and elsewhere.*[27]

Oxlip still occurs in Kingston Wood, but Madingley is one of the few places from which it has disappeared. After Ray, it was recorded by John Martyn, who annotated his copy of Ray's list for the wood "Primula major pall.", and in Thomas Martyn's flora in 1763. The only later record is that of W.H. Coleman in 1834–36, who said it grew in the strip of woodland C5.[28] We regard John Martyn's as the latest reliable record: Thomas Martyn, who knew Madingley Wood but gives no manuscript note of this plant, may have copied his father, and Coleman is known to have committed the characteristic Victorian error of confusing Oxlip with the Primrose–Cowslip hybrid.[29]

What happened to the Oxlip? Madingley Wood is not waterlogged enough to be an ideal Oxlip site like Hayley. The most likely explanation is that there was a large population in the eastern half of the wood, grubbed out soon after Ray's time. Possibly it lingered on in hedges between the fields but died out before this part reverted to woodland.

Plants of ancient woodland

Madingley Wood has 14 species which are characteristic of ancient woodland in Eastern England.[30] If these are weighted according to the degree of affinity with ancient woodland (e.g. Oxlip scores 3, Primrose scores 1), the total score comes to 40. Hayley Wood, three times the area of Madingley, has 28 ancient-woodland species and scores 73; Gamlingay Wood, three times the area of Madingley, has 24 ancient-woodland species and scores 61; and Knapwell Wood[31], one-quarter the area of Madingley, has 14 ancient-woodland species and scores 32. Madingley thus compares rather poorly with other west Cambridgeshire woods – though it is clearly separated from White pits Plantation (see Figure 2), some 200 years old, which has one ancient-woodland plant and scores 1.

However, if we include plants known from 17th-, 18th- and 19th-century records, the position changes. The lost species include nine of ancient woodland (score 23). Including these brings the score up to 63. Madingley Wood in Ray's time was at least as rich in ancient-woodland plants, taking its size into account, as Hayley or Knapwell Woods are now.

Lost plants of Madingley Wood

Of the 224 flowering plants and ferns which have ever been recorded from Madingley Wood, 51 – over one-fifth – appear to have died out between 1660 and 1960. (This number has been slightly reduced by recent rediscoveries, such as *Calamagrostis epigejos* reappearing in 1985 in a felled area after a lapse of over 200 years.) This extinction rate, however, may be an underestimate: of plants that have historical records, half have disappeared (Table 3).

Table 3: Survival rate of plants with historical records

	Total	*Surviving*	*Extinct*
Species recorded before 1700	31	17	14
Species recorded before 1800	54	27	27
Species recorded before 1900	97	52	45

Table 4: Period of extinction of extinct species

Extinct before 1700	2 species	Extinct 1850–1900	12 species
1700–1750	4	1900–1950	4
1750–1800	11	since 1950	8
1800–1850	10		

We might suppose that the destruction of part of the wood exterminated species other than Oxlip. However, other woods – Kingston (also recorded by John Ray), Ken Wood in Hampstead, Bradfield Woods – have also lost species although their areas did not change.[32] All woods known in sufficient detail have lost species with time, though seldom as many as Madingley.

When did these species disappear? The Madingley records were not made in order to study future extinctions: the last mention of a plant may be several decades before it died out. Last records are mainly between 1750 and 1890 (Table 4), which indicates that most extinctions occurred between about

1780 and 1920. This suggests that grubbing out part of the wood, though it may have exterminated Oxlip, was not a major factor. The extinctions were especially at a time when the wood was increasing in area, overgrowing the wood-closes, and was getting more shady as coppicing ceased and conifers were introduced.

This is confirmed by the nature of the lost plants (Table 5). Only 12 out of the 51 will live in continuous shade, although some even of these, such as Oxlip, do better under coppicing. Many were general grassland plants, such as Cowslip *Primula veris* and Bee Orchid *Ophrys apifera*. Nearly half the total were non-shade-tolerant woodland plants. Some were 'woodland-grassland' species, which do not withstand shade but live in permanent rides and glades. (They are not to be confused with the 'coppicing plants' of temporary open areas.) These include, among Ray's records, *Stachys (Betonica) officinalis*, *Campanula trachelium* and *Serratula tinctoria*. This category of plants is known from the pollen record to go back to the prehistoric wildwood.[33] Others were the plants of the 'circumboscal zone' which used to exist around the edges of ancient woods. The remains of this zone at Hayley still contain *Cirsium eriophorum*, *Valeriana officinalis* and *Campanula trachelium*.

Table 5: Plants lost from Madingley Wood

Trees & shrubs	*Ligustrum vulgare* *Rosa tomentosa*	*Sorbus aucuparia* *Ulex europaeus*	*Viburnum opulus*
Weeds & cultivated plants	*Campanula rapunculoides* *Euphorbia exigua*	*Rumex obtusifolius* *Symphytum officinale*	*Vinca major*
Grassland	*Anacamptis pyramidalis* *Carex divulsa* *Carex spicata* *Filipendula vulgaris*	*Gymnadenia conopsea* *Lathyrus pratensis* *Linum perenne* *Mentha arvensis*	*Ophrys apifera* *Poa pratensis* *Primula veris* *Trifolium ochroleucon*
Circumboscal	*Campanula glomerata* *Cirsium eriophorum* *Elymus caninus*	*Lathyrus sylvestris* *Melampyrum cristatum* *Primula veris* x *vulgaris*	*Valeriana officinalis* *Vicia hirsuta*
Woodland grassland	*Calamagrostis canescens* *Campanula trachelium* *Carex remota*	*Conopodium majus* *Cruciata laevipes* *Lithospermum officinale*	*Serratula tinctoria* *Stachys officinalis* *Succisa pratensis*
Shade-tolerant, responding to coppicing	*Milium effusum* (native)	*Primula elatior*	
Shade-tolerant	*Epipactis helleborine* *Equisetum sylvaticum*	*Platanthera chlorantha* *Poa nemoralis*	*Polypodium vulgare* *Sanicula europaea*
Parasitic	*Lathraea squamaria*	*Monotropa hypopitys* (two subspecies)	*Neottia nidus-avis*

Lost shade-tolerant plants at Madingley include three mysterious, unrelated species, Yellow Bird's-nest *Monotropa hypopitys* subspp. *hypophegea* and *hypopitys*, Bird's-nest Orchid *Neottia nidus-avis* and Toothwort *Lathraea squamaria*, which have no chlorophyll and live as parasites upon their mycorrhizal fungi. In the 19th century Madingley Wood was probably the best locality in Cambridgeshire for them. *Monotropa* was first recorded by Relhan in 1793, not in the wood but in "Madingley Plantations", which suggests that it (and its supporting fungi) may have been introduced to the area on the roots of imported conifers. All four plants are now generally declining for unknown reasons.

Madingley Wood was thus specially rich in plants transitional from woodland to grassland. Wood-closes made excellent habitats for woodland-grassland and circumboscal plants. Like all small fields next to woods, they were unstable and easily reverted to woodland, with the loss of their distinctive plants. As a sketch-map of the 1830s shows (Figure 4e), wide grassy tracks lined the north and east sides of the wood. The eastern one has been destroyed and the northern one overgrown by the wood; remnants of the latter's flora survived into the mid 20th century.

This has a general moral. Much of the flora and fauna of woods depends on their edges and the lanes round them. During this century these transitional zones have been destroyed through farmers ploughing them up and through trees overgrowing them. Although ploughing-up is now out of fashion, woods still encroach, making woodland-grassland and circumboscal plants, such as *Melampyrum cristatum*, the most threatened of the woodland flora. (This now nationally scarce and declining species was described by Ray in 1660 as occurring "*almost in all woods in this County plentifully; likewise it overspreads all the pasture or common ground you ride through going out of Madingly to dry Draiton*".) Even on a nature reserve, maintaining the woodland-edge flora, as on the Hayley Wood railway, takes much effort and is not certain of success. Sooner or later the person responsible will be promoted or sacked, to be replaced (if at all) by someone who forgets the importance of edges.

Conclusions

Madingley Wood illustrates the principle that all ancient woods are uniquely different. An apparently ordinary wood, which happened to come to the University with an estate, turns out to tell an unexpected story, whose complexities have still to be fully worked out. It illustrates general features, such as the principle that plantations next to, or inside, natural woods fall into neglect and slowly come to approximate to natural woodland. It also has features which are known nowhere else. Much of its value for research is in directions which were unsuspected when it was acquired as a research site.

Many aspects of ecology, especially in woodland, can be understood only through observations continued over decades or centuries. The practice of making observations dependent on research grants and three-year Ph.D. courses prevents these aspects from being studied. The philosophy, now fashionable, of designing observations only in order to confirm or disprove some preconceived hypothesis makes it difficult to discover the unexpected.[34] At Madingley Wood, along with Wytham Woods and Lady Park Wood (v.c. 35: Monmouth, now Gwent)[35], the long duration of existing studies makes it possible to break out of these limitations. Only at Madingley are 46 years of existing studies preceded by 300 years of earlier records. Ecological science, which largely was founded at Cambridge, has become unfashionable in the University, but will not be for ever under a cloud. It is most important to keep at least minimum recording going in Madingley Wood to serve as a basis for the next 300 years of woodland research.

Table 6: List of flowering plants and ferns in Madingley Wood
(by D.E. Coombe, G. Crompton & O. Rackham)

In the 18th and 19th centuries, only one plant record per century is normally given. The earliest and latest records, however, are always included. A1, E2, etc. are locations on the map (Figure 3).
Principal names are those of Clive Stace's (1991) *New Flora of the British Isles.*

*	Introduced
**	Deliberate introduction (e.g. planted tree)
§	Associated with felling or coppicing
†	Specimen in **CGE** (see below)
AJR	A.J. Richards
ASS	A.S. Shrubbs
BATHG	Herbarium of Geology Museum in Royal Literary and Scientific Institution, Bath
CCB	C.C. Babington
CCB m	C.C. Babington's MS of localities, *c.* 1830–1880, in the library of the Department of Plant Sciences, Cambridge
CGE	Cambridge University Herbarium
CUBG	Cambridge Botanic Garden Herbarium
FC	Notes in **CGE** collected for *A Flora of Cambridgeshire* (Perring *et al.*, 1964)
FHP	F.H. Perring
JM	J. Martyn's underlining, in his interleaved copy of Ray (1660) in the library of the Department of Plant Sciences, Cambridge, of references to Madingley Wood or of species listed for it in Ray I, indicating his confirmation of Ray's records
JM n	J. Martyn's annotations in the same interleaved copy of Ray (1660)
JSH	J.S. Henslow
HD	H.N. Dixon
LJ	Leonard Jenyns, *alias* Blomefield, specimens in **BATHG**
MCA	M.C. Anderson
MP	Madingley Plantations (not part of Madingley Wood)
NHS	Cambridge Natural History Society's card index in **CGE**
PDS	P.D. Sell
Ray	J. Ray, *Catalogus plantarum circa Cantabrigiam nascentium*, Cambridge, 1660
Ray I	J. Ray, *Index plantarum agri Cantabrigiensis* (bound with most copies of Ray, 1660, but separately paginated), including *Index locorum* (with plant list for Madingley Wood on p. 33): all the Madingley Wood plants in Ray (1660) are also listed here except *Campanula trachelium* and *Primula elatior*.
Rc	Age of trees based on count of annual rings
RR	R. Relhan, *Flora Cantabrigiensis*, Cambridge, 1785; supplements 1786 and 1793; new editions 1802 and 1820
SCB	S.C. Baker
SIW	S.I. Warwick
SW	S. Wegmüller
SWN	Herbarium of Saffron Walden Museum

TM	T. Martyn, *Plantæ Cantabrigienses*, London, 1763
TM n	T. Martyn's annotations in a copy of his father J. Martyn's *Methodus plantarum circa Cantabrigiam nascentium* (London, 1727) in the library of the Department of Plant Sciences, Cambridge
WHC	W.H. Coleman, notebooks among Babington MSS in the library of the Department of Plant Sciences, Cambridge
WLPG	Revd W.L.P. Garnons, specimens in SWN
WMF	W.M. Frost
WW	W. West junior, note in CCB's (1860) *Flora of Cambridgeshire*

Species	*17th century*	*18th century*	*19th century*	*20th century*
Acer campestre	Old stools ———			Abundant
***A. pseudoplatanus*	—	—	—	Plantation in Panhandle
***Aesculus hippocastanum*	—	—	—	Planted A1, C6; seedling D4 ('85)
Agropyron caninum	See *Elymus caninus.*			
Agrostis stolonifera	—	—	—	§ DEC '85 local
Ajuga reptans	—	—	WLPG '24	OR '75; very abundant
Alliaria petiolata	—	—	—	W margin (OR '96)
Alopecurus myosuroides	—	—	—	§ D4 (DEC '85)
A. pratensis	—	—	—	§ D4 (DEC '85) one plant
Anacamptis pyramidalis	—	—	WHC '33 [in C9]; ASS '78	—
Anagallis arvensis	—	—	—	§ D4 (DEC '85) rare
Anemone nemorosa	Ray, "plentifully"	JM; TM n	JSH & LJ (BATHG) '22	NHS; A3 (DEC '90); local, damp rides; includes purple form
Angelica sylvestris	—	—	—	F1 (DEC '96)
Anthriscus sylvestris	—	—	—	FC; OR '75; DEC '96
Arctium minus	—	—	CCB† '53	NHS; § A1 (DEC '96)
Arrhenatherum elatius	—	—	—	§ D4 (DEC '85) three clumps
Arum maculatum	—	—	—	OR '75; very abundant
Atriplex patula	—	—	—	§ D4 (DEC '85), "abundant"
Betonica officinalis	See *Stachys officinalis.*			
Betula pendula	—	—	—	§ C9 (DEC '90)
B. pubescens	—	—	—	§ D3 (OR '69), D4, C9
Brachypodium sylvaticum	—	JM n, "Gramen avenaceum dumetorum spicatum"	—	NHS; § OR '95; DEC '96

Table 6 contd	*17th century*	*18th century*	*19th century*	*20th century*
Bromopsis ramosa (*Bromus ramosus*)	—	—	WLPG '40	FC; § A1, A2 (OR '95)
Bryonia dioica	—	—	—	OR '75
***Buxus sempervirens*	—	—	—	PDS† '61; Victorian bushes A, D1
Calamagrostis canescens	—	RR '85	—	—
C. epigejos	—	TM	—	§ D4 (DEC '85); A1, A2, D3, D4 (OR '95)
Callitriche stagnalis	—	—	—	DEC '85 wet rides
Calystegia sp.	—	—	—	F1 (OR '71)
Campanula glomerata	—	TM n '59 (edge of wood)	—	—
C. rapunculoides	—	—	WMF† '51 (plantation adjoining)	—
C. trachelium	Ray	JM n	—	—
Cardamine pratensis	—	—	—	OR '71 rides, also §; A2 (DEC '96)
Carduus crispus	—	—	—	§ DEC '85
Carex divulsa	—	—	RR '02	—
C. otrubae	—	—	—	DEC '85; §D4 (OR '95)
C. pendula	—	—	—	§ D4 (DEC '90); E1 (OR '96)
C. remota	—	RR '93	—	No later record
C. spicata	—	—	WHC	—
C. sylvatica	Ray, "plentifully"	JM	CCB m	NHS; DEC '85; § and rides, plentiful
Carpinus betulus	—	—	—	OR '75; rare, C6
Centaurium erythraea	—	—	—	D1 (DEC '85)
Cerastium fontanum	—	—	—	DEC '85, '96
***Chamaecyparis* sp.	—	—	—	Row at E. edge of E2
**Chamerion* (*Epilobium*) *angustifolium*	—	—	—	DEC '85 mainly §
Chenopodium album	—	—	WLPG '40	§ D4 (DEC '85)
C. polyspermum	—	—	—	C8, one plant (DEC '50); C1 (OR '71) (on rides)
C. rubrum	—	—	—	§ D4 (DEC '85)
Circaea lutetiana	—	—	—	NHS; OR '75; DEC '96; frequent, partly §
Cirsium arvense	—	—	—	§ A1, A2 (OR '95) local

Table 6 contd	*17th century*	*18th century*	*19th century*	*20th century*
Cirsium eriophorum	Ray I		WHC in CCB m, "wood closes"	NHS, "by wood"; absent DEC '90
C. vulgare	—	—	—	§ A1, A2 (OR '95)
Clinopodium vulgare	—	—	Anon. '88 (CGE)	NHS; DEC '85
Conopodium majus	—	—	WLPG '40	—
**Conyza (Erigeron) canadensis*	—	—	—	§ D4 (DEC '85)
Cornus sanguinea	—	—	CCB m	OR '75; seedling in felled area D4 ('85)
Coronopus squamatus	—	—	—	§ D4 (DEC '85), "abundant"
Corylus avellana	—	—	Old stools	Abundant
Crataegus laevigata	—	—	—	NHS; only 4 plants identified, C8 (DEC '85)
C. monogyna	—	—	—	PDS† '61; abundant
Crepis capillaris	—	—	—	§ D4 (DEC '85)
Cruciata laevipes	Ray I	—	—	—
Dactylis glomerata	—	—	—	NHS; § A1, A2, D4 (DEC '85, OR '95)
Dactylorhiza fuchsii	—	JM n, "Orchis palm. mac."	WHC '33, "very plentiful" [E. edge]	Damp spots on rides, especially D2 (DEC '90)
Deschampsia cespitosa	—	—	—	§ D4 (DEC '85) rare
Dryopteris dilatata	—	—	—	A1, A2, A3 (OR '71) first recorded on fallen oak, later abundant
D. filix-mas	—	—	—	OR '75; DEC '96; partly §
Elymus caninus (Agropyron caninum)	—	TM n	—	—
**Epilobium angustifolium*	See **Chamerion angustifolium*.			
**E. ciliatum (E. adenocaulon)*	—	—	—	NHS; DEC '85; very scarce?
E. hirsutum	—	—	—	§ A1, A2, D4 (DEC, OR '85–'95)
E. montanum	—	—	—	NHS; FHP† '50; local as §
E. parviflorum	—	—	—	FC; § A1, A2, D4 (DEC, OR '85–'95)
E. tetragonum	—	—	—	DEC '85 frequent

Table 6 contd	*17th century*	*18th century*	*19th century*	*20th century*
Epipactis helleborine	—	—	RR '20	—
Equisetum sylvaticum	—	TM n	—	—
Euonymus europaeus	Ray	TM n '59	JSH† '21, '27	NHS; DEC '85, '96; sparse except at W. end
Euphorbia exigua	—	—	Anon. '88 (CUBG)	—
***Fagus sylvatica*	—	—	—	Mainly along road frontage
Festuca gigantea	—	—	—	FC; § (DEC '85) rare
Filipendula ulmaria	Ray I	JM; (TM)	—	NHS; frequent
F. vulgaris	—	JM n; TM n '59	WHC '34, "within the plantations of Madingley Wood"	—
Fragaria vesca	—	—	CCB m	DEC '51; D4 (DEC '85)
Fraxinus excelsior	Old stools	Rc *c.* '90	Old trees	Abundant
Galium aparine	—	—	WLPG '40	Abundant
G. palustre	—	JM n	—	§ A1, A2 (OR '95)
Geranium pratense	—	—	WHC in CCB m, "closes by wood"	Road verge opposite S. of wood (OR '71)
G. robertianum	—	—	ASS† '78	Bark of felled dead elms, C9 (DEC, OR '85)
Geum urbanum	—	—	—	NHS; § (OR '95)
Glechoma hederacea	—	—	—	NHS; very abundant
Gymnadenia conopsea	—	—	ASS '90 (in NHS)	—
Hedera helix	—	—	ASS† '98	NHS; surprisingly local
Heracleum sphondylium	—	—	—	NHS; OR '75; DEC '96; rides
Holcus lanatus	—	—	—	DEC '85
***Hordelymus europaeus*	—	—	—	Introduced at photosite by MCA *c.* '65 for experiments; seeded, persisted 2–3 years; native in Knapwell Wood
Hyacinthoides non-scripta (Endymion non-scriptus)	Ray	JM	LJ '22	NHS; abundant

Table 6 contd	*17th century*	*18th century*	*19th century*	*20th century*
Hypericum hirsutum	—	—	CCB†	OR '71; DEC '96; mainly §
Ilex aquifolium	—	—	JSH† '29; anon.† '78	B1 (OR '96); continuity doubtful
***Impatiens parviflora*	—	—	—	Introduced for experiments '50 (DEC); has persisted and is now abundant
Juncus conglomeratus	—	—	—	§ A1, A2 (OR '95)
J. effusus	—	—	—	FC; A3, by fallen elms (OR '95)
J. inflexus	—	—	—	§ A1, A2, D4 (OR '95)
Lactuca serriola forma *integrifolia*	—	—	—	§ D4 (DEC '85)
Lamiastrum galeobdolon subsp. *montanum*	Ray	JM	JSH† '22, '26	NHS; SW† '69; in D2, D3
***Larix decidua*	—	—	—	Rc '09; surviving D1, formerly D3, D4
Lathraea squamaria	—	—	ASS '89 (in NHS)	—
Lathyrus pratensis	Ray I	JM	—	—
L. sylvestris	Ray	—	—	—
Lemna minor	—	—	—	C8 pond (DEC '85)
Ligustrum vulgare	Ray I	TM	WLPG '40	DEC '51
Linum perenne subsp. *anglicum*	—	TM n '59 (by wood)	—	—
Listera ovata	Ray I	JM	—	NHS; DEC *c.* '50 ; OR '75
Lithospermum officinale	—	—	—	FC; may have lingered till *c.* 1965 near S. entrance (DEC)
Lolium perenne	—	—	—	§ D4 (DEC '85) one clump
Lonicera periclymenum	—	—	—	C7 (OR '96); very rare
Lysimachia nummularia	—	—	—	§ D4 and ride C9 (DEC '85, OR '95)
***Mahonia aquifolium*	—	—	—	F1 (DEC '90) one plant
Malus sylvestris	—	—	—	FC; frequent, includes *M. domestica* and hybrids
Melampyrum cristatum	Ray, "plentifully"	JM; TM n '59	WHC, "closes at wood"	—
Mentha arvensis	—	—	JSH† '24, "closes by wood"	FC
Mercurialis perennis	Ray I	JM	LJ '22	NHS; abundant

Table 6 contd	*17th century*	*18th century*	*19th century*	*20th century*
Milium effusum	—	RR '85	—	Reintroduced at photosite by MCA *c.* '65 for experiments; still there (OR '96)
Moehringia trinervia	—	—	—	DEC '63; D2 (DEC '85); very rare in W. Cambs
Monotropa hypopitys subsp. *hypophegea*	—	—	ASS† '78 (det. PDS)	—
M. hypopitys subsp. *hypopitys*	—	[RR '93 MP]	[SCB† '35 MP]; CCB m '73; NHS '78; ASS† '90 (det. PDS)	—
Neottia nidus-avis	—	RR '85	—	—
Ophioglossum vulgatum	—	—	WHC '34, "grass about wood"	NHS; D1 (DEC '90)
Ophrys apifera	—	RR '85	—	—
Orchis mascula	Ray, "copiosé"	JM	CCB m	NHS; especially A1 (DEC)
Persicaria maculosa (*Polygonum persicaria*)	—	—	—	Ride (OR '85)
Phleum pratense	—	—	—	DEC 28.9.85 one clump
Phragmites australis	—	—	—	§ D4 (OR '95)
***Picea abies*	—	—	Rc '73	A2, B1; recent plantation in E2
Picris echioides	—	—	—	OR '78, '95 partly §
Platanthera chlorantha	Ray	JM	RR '20; ASS† '86, '88, '90	DEC *c.* '52, "almost certain" – one flowering plant
Poa annua	—	—	—	DEC '85; locally abundant
P. nemoralis	—	RR '85	CCB m	—
P. pratensis	—	—	WLPG '40	—
P. trivialis	—	—	—	OR '75, '95; very abundant
Polygonum aviculare	—	—	—	§ D4 (DEC '85) perhaps *P. rurivagum*
P. persicaria	See *Persicaria maculosa*.			

Table 6 contd	*17th century*	*18th century*	*19th century*	*20th century*
Polypodium vulgare agg.	—	—	—	3 fronds on dead oak, A3 (DEC '76), first Cambs record on natural substrate; killed by '76 drought
***Populus* x *canadensis*	—	—	—	Plantation in E1
***P. nigra* 'Italica'	—	—	—	N. edge of E1 (OR '96)
Potentilla reptans	—	—	—	§ D4, crevice of ash stool (DEC '85); ride C9 (OR '96)
P. sterilis	—	TM n	JSH† '22; WHC	F1 (DEC '51, '90)
Primula elatior	Ray, "abun-dantly"	JM n; ?TM n	—	—
P. veris	—	TM	—	[Adjacent to wood at F2 (DEC '96)]
P. vulgaris	—	TM	CCB; ASS† '99	NHS; OR '66 scattered in D1; F1 (DEC '96)
P. veris x *vulgaris*	—	—	—	NHS; DEC '50–*c.* '70 near W. edge, now overgrown with elm
Prunella vulgaris	—	—	—	FC; SIW† '74; DEC '85
***Prunus laurocerasus*	—	—	—	N. edge of E1 (DEC '52, OR '96)
P. spinosa	—	—	—	NHS; abundant
Quercus robur	Ray I	JM n; rc *c.* 1785 (C8)	Rc 1817 (A3)	Abundant
Ranunculus acris	—	—	—	§ D4 (DEC '85) one plant
R. auricomus	—	—	WHC '35	DEC† '50; C8 (DEC '90, '96)
R. ficaria	—	—	—	OR '75; mainly or all subsp. *bulbilifer*, characteristic of disturbed places, absent from Buff and Hayley Woods
R. repens	—	—	—	FC; OR '75, '95 partly §
R. trichophyllus	—	—	—	C8 pond (DEC '85)
Reseda luteola	—	—	—	§D4 (DEC '85) rare; outside S. gate (OR '96)
Rhamnus cathartica	Ray	TM	WLPG '40	NHS; DEC '70s; OR '85; 2 bushes, C1a, C6
Ribes nigrum	—	—	—	D4 (DEC '90), C8 (OR '96)

Table 6 contd	*17th century*	*18th century*	*19th century*	*20th century*
Ribes rubrum	—	—	—	NHS; *SMW*† '61; DEC '96; partly §
R. uva-crispa	—	—	—	DEC *c.* '60; thicket A3
Rosa arvensis	—	—	CCB m	Frequent
R. canina	—	—	—	Abundant, edges etc.
R. tomentosa	—	—	CCB m	—
Rubus caesius	—	—	—	FC; § D4 (DEC '85)
R. sect. Corylifolii	—	—	—	§ A1, A2, D4 (OR '79, '95)
R. ulmifolius	—	—	—	§ A1, A2, D4 (DEC '85, OR '95)
R. ?vestitus	—	—	—	§ A1, A2, D4 (DEC '85, OR '95)
Rumex crispus	—	—	WLPG '40	OR '75; DEC '85
R. obtusifolius	—	—	WLPG '40	—
R. sanguineus	—	—	—	FC; DEC '85; abundant
Salix alba	—	—	—	§ D4, one plant (DEC '85)
S. caprea	—	—	—	FC; OR '71; locally abundant, part §
S. cinerea	—	—	—	§ D4 (DEC '85); locally abundant
S. fragilis	—	—	—	One tree between A2 and A3 (OR '67)
S. viminalis	—	—	—	§ D4 (DEC '90)
Sambucus nigra	—	—	CCB† '41	NHS; abundant
Sanicula europaea	Ray I	JM	WLPG '40	NHS; DEC '51
Scrophularia nodosa	Ray	JM	CCB m	FC; DEC '85; OR '95 partly §
Senecio erucifolius	—	—	—	§ A1, A2 (OR '95)
S. jacobaea	—	—	—	§ D4 (DEC '85); A1/2 (DEC '96)
S. vulgaris	—	—	—	D4 (DEC '85)
Serratula tinctoria	Ray I	JM; TM n '59	JSH† '27	—
Solanum dulcamara	—	—	—	§ D4 (DEC '85)
S. nigrum	—	—	—	§ D4, rare (DEC '85)
Sonchus arvensis	—	—	—	§ D4, locally abundant (DEC '85)
S. asper	—	—	—	§ D4, frequent (DEC '85)
S. oleraceus	—	—	—	§ D4, one plant (DEC '85)
**Sorbus aucuparia*	—	—	—	DEC '51
Stachys (Betonica) officinalis	Ray I	JM; TM n '59	CCB m; *ASS* '89	NHS

Table 6 contd	*17th century*	*18th century*	*19th century*	*20th century*
Stachys sylvatica	—	—	—	FC; FHP† '50; § D4 (DEC '85)
Stellaria holostea	Ray I, "Gramen leucan-themum"	JM; TM	WW, "S.W. corner"	NHS; F1, F2, locally abundant (DEC '90)
S. media	—	—	—	§ D4, rare (DEC '85)
Succisa pratensis	—	—	CCB m	—
***Symphoricarpos albus* (*S. rivularis*)	—	—	—	PDS† '61; C3, E1, E2
**Symphytum officinale*	—	—	WHC	—
Tamus communis	—	—	—	DEC '51, '96
Taraxacum latisectum	—	—	—	PDS† '58 (det. AJR)
T. parvuliceps	—	—	—	PDS† '58 (det. AJR)
Torilis japonica	—	—	—	§ A1, A2 (OR '95)
Trifolium ochroleucon	—	TM n '59 (about wood)	—	Roadside before American Cemetery landscaping (DEC '48)
Tripleurospermum inodorum	—	—	—	§ D4 (DEC '85) one plant
**Triticum aestivum*	—	—	—	A3, photosite (OR '79)
Tussilago farfara	—	—	—	§ B1 (OR '71); § D4 (DEC '85, '90)
Ulex europaeus	—	—	CCB m; HD *c.* '87 (in NHS)	—
Ulmus glabra	—	—	Old stool	One big stool, A1 (OR '67)
U. minor	Big clone, A3	———	Old trees rc *c.* 1860	Still flourishing
U. procera	—	—	Clone	OR '68; now suckers only
U. glabra–minor intermediate	—	—	Clone	Rare
Urtica dioica	—	—	—	NHS; increased since '50
Valeriana officinalis	Ray, "about the wood"	JM	CCB† '37; WLPG '40	NHS
Veronica agrestis	—	—	—	FHP† '50
V. beccabunga	—	—	—	C8 pond (DEC '85, OR '95)
V. chamaedrys	—	—	—	NHS; OR '75; DEC '85; F2 (DEC '96)
**V. filiformis*	—	—	—	Ride D2 (DEC '90)

Table 6 contd	*17th century*	*18th century*	*19th century*	*20th century*
Veronica officinalis	—	JM n, "Veronica mas supina"; TM	—	F1 (DEC '51, '90)
V. serpyllifolia	—	TM n	—	NHS; § D4, occasional (DEC '85)
Viburnum lantana	Ray I	JM	CCB m	Roadside (DEC '85); edge of A2 (DEC '90); E2 (OR '96)
V. opulus	Ray I, "Sambucus aquatica"	TM	CCB m	—
Vicia hirsuta	—	JM n	—	—
V. tetrasperma	—	—	—	§ D4, one patch (DEC '85)
***Vinca major*	—	JM n, "Pervinca major"; TM n	—	—
Viola hirta	—	—	WLPG '26	FC; DEC '51; DEC '90, '96 (C6, F1)
V. odorata	—	—	—	DEC '51, '85, '90, '96 (C6, purple form)
V. reichenbachiana	—	—	?WLPG '40 (as *V. canina*); ASS '87	NHS; DEC '52, '90, '96; *V. riviniana* also probable but unconfirmed

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The Rook *Corvus frugilegus* in Cambridgeshire

Graham Easy

The notebooks of the late Arnold Darlington have surfaced and been found to include details of part of the earliest complete count of rookeries in 'old' Cambridgeshire (compiled by R.G. Newton in 1944/45). The area Darlington surveyed is shaded in Figure 1. One important feature of his contribution was that he noted the tree species used by nesting birds. Table 1 compares his results with more recent surveys undertaken in 1989 and 1995; these figures and those given in Table 2 show the scale of the Rook's reduction from its population half a century ago and the dramatic change in tree species occupied.

Rooks' tree preferences

Elm was obviously the Rook's preferred tree (see 1944/45 figure in Table 1). Unfortunately, since the attack of Dutch Elm Disease in the 1970s, mature elms are now rarities, while in the 1940s almost every view in the county was dominated by them. Poplar and willow species and their hybrids now chequer the Fenland scene and are present in ever increasing abundance across South Cambridgeshire, having been used extensively for ornament or to provide shelter-belts. Willows have also spread naturally into waste ground and by pits and waterways. Whilst these trees have taken the place of elms numerically in our environment, the 1989 and 1995 surveys show that neither is favoured by the Rooks; the sticky buds of the poplars, the 'whippy' branches of the willows and the twig formation of both normally prove unsuitable for their nest-building requirements. In contrast, the stature of the elms, with their accommodating branches and solid boughs, made them ideal nesting sites and observation posts; indeed the trees taking top places in the table now are Beech, Sycamore and Ash, which have a similar overall structure.

Rooks nesting in an Ash **Graham Easy**

Pedunculate Oak, on the other hand, which has a similar appearance and is quite commonly distributed in South Cambridgeshire, has never been a particularly sought-after tree; possibly the branch formation is unsuitable in some way. It is surprising to find that Horse-chestnut is so often used, despite its sticky buds, which must cause problems during nest construction. Horse-chestnut numbers are considerably lower than those of the other three preferred species, suggesting that this is the most prized tree at the present time.

Two unlikely evergreens feature quite significantly. Black Pine, with its platform format of boughs and branches and ever-present leaf canopy, seems to offer considerable protection at the nest construction stage when all deciduous trees are bare. Similarly, the comparatively rare evergreen Holm Oak is often chosen.

These surveys have shown that there is no shortage of suitable nest sites for the Rook since the loss of the elms. Indeed there must be more trees in the county than for many centuries after the amount of planting that has taken place over recent decades. Admittedly the majority of these are comparatively young trees; however even hawthorn hedgerows and low willow thickets are used as nest sites in the vicinity of special feeding opportunities such as rubbish-tips. It must therefore follow that loss of trees such as that caused by Dutch Elm Disease has no great influence on overall Rook numbers, although obviously distribution will change.

Fluctuations of the Rook population during the 50 years surveyed

Table 2 shows the well-documented plummet of breeding numbers since the 1950s but also details the significant upturn in 1995. Before the reasons for this unexpected recent increase are tackled, a resumé of the main causes of the earlier decline seems essential.

It would appear that the Rook's predation on pasture and crop-damaging insects secured its place in farmland up to 1950. Thus a species with an otherwise bad reputation due to its attacks on sown and ripened crops was allowed to colonise farmsteads, since farmers appreciated these redeeming practices and were prepared to spend time scaring 'crows' from susceptible crops. Certainly adequate grassland was available to provide alternative feeding sites once birds had been disturbed from the arable areas. The following decades saw the end of this coexistence, when much of the grassland in the region was turned into arable fields and chemical sprays were used to annihilate harmful insects and other pests. The Rook, its beneficial role no longer required, became the enemy, without any significant points in its favour, and was dealt with severely as its crop attacks became more pronounced owing to the general lack of other foraging areas.

The decline in Fenland was dramatic: numbers of rooks were down to a third by 1955, with only 600 or so pairs nesting over the whole area of North Cambridgeshire early in the 1980s. Certainly their ingestion of the very poisonous seed dressings in use at that time accelerated their demise. It also seems that the long flights across the fens from distant roosts in the more upland areas had an effect, since the fall in numbers was never as pronounced in the south of the county, where three of these roosts were established. It could well be that the Rooks remained nearer these centres to breed rather than venturing across the 'hostile' fenland arable where farmers waged their shotgun war against them. Indeed by the 1970s most surviving rookeries were restricted to villages, near main roads or other areas where shooting was illegal or discouraged.

The increase

The 1995 increase was evident at almost all the rookeries right across the county. There had been the potential for an increase with the introduction of set-aside (the practice of forcing farmers to leave a percentage of their arable land uncropped to reduce the European food surpluses). It was hoped that these areas would enable the Rook and other species to find food without coming into conflict with farmers. Surveys in progress should give firm evidence if this has indeed been the result. Some of our more successful populations have been where grassland has increased with extended racehorse paddocks and exercise areas and the introduction of Red Deer farming; by contrast, in most areas where set-aside is conspicuous Rook populations have shown but little improvement. Possibly aiding the increase has been the recent tightening of the law concerning shotgun ownership, which has meant that a significant number of those not able to provide secure armouries have not been given shotgun licences. This has certainly reduced the number of 'cowboys' in the countryside and, as a result, some rookeries may not have been used as regular target practice as in the past.

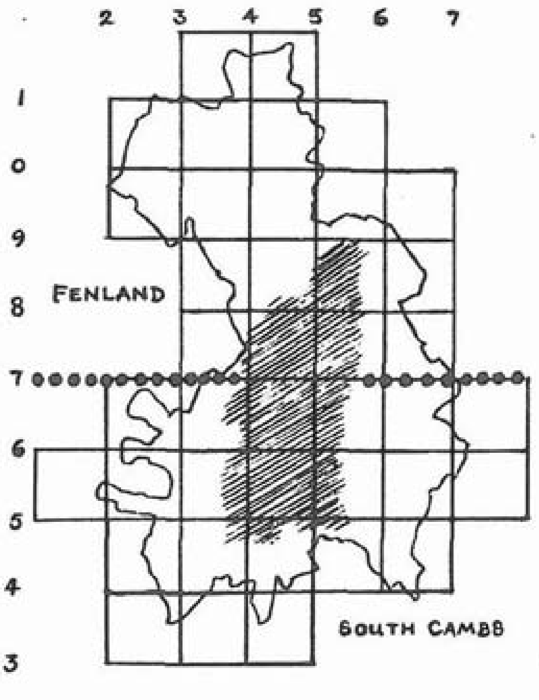

Figure 1: Sketch-map of Cambridgeshire (v.c. 29) with the area surveyed by Arnold Darlington in 1944/45 shaded ('Sample' in Table 1)

Table 1: Numbers of Rook nests in various trees in the three surveys

Survey	Elms *Ulmus* spp.	Beech *Fagus sylvatica*	Sycamore *Acer pseudo-platanus*	Ash *Fraxinus excelsior*	Horse-chestnut *Aesculus hippocastanum*
Sample 1944/45	4677	155	141	477	325
Sample 1989	202	223	449	369	315
Sample 1995	181	81	453	707	501
Total 1989	320	1076	859	840	716
Total 1995	455	1369	1301	1534	1163

Survey	Black Pine *Pinus niga*	Scots Pine *Pinus sylvestris*	Willows *Salix* spp. (mainly *S. alba*)	Poplars *Populus* (mainly hybrids)	Alders *Alnus* spp.
Sample 1944/45	–	–	67	46	47
Sample 1989	70	–	189	72	–
Sample 1995	120	14	375	118	2
Total 1989	246	21	246	188	–
Total 1995	302	185	590	385	2

Survey	Oak *Quercus robur*	Plane *Platanus* × *hispanica*	Holm Oak *Quercus ilex*	Limes *Tilia* spp.	Cedars *Cedrus libani* etc.
Sample 1944/45	53	39	–	–	–
Sample 1989	35	27	5	4	–
Sample 1995	32	32	3	22	7
Total 1989	98	41	27	12	24
Total 1995	195	88	40	108	65

Survey	Cypress ×*Cupresso-cyparis* etc.	Hawthorn *Crataegus monogyna*	Walnut *Juglans regia*	Maples *Acer* spp.	Spruce *Picea abies*
Sample 1944/45	–	–	–	–	1
Sample 1989	3	5	2	3	2
Sample 1995	–	15	–	1	–
Total 1989	7	5	4	3	2
Total 1995	–	22	4	12	8

Survey	Yew *Taxus baccata*	False-acacia *Robinia pseudoacacia*	Hornbeam *Carpinus betulus*	Total numbers of nests in the sample area	
Sample 1944/45	–	–	–	1944/45	6038
Sample 1989	2	–	1	1989	1979
Sample 1995	3	–	–	1995	2667
Total 1989	2	1	1		
Total 1995	15	6	1		

Touring the county in 1995 brought to light a number of problems facing Rooks. Since the rookeries are now situated close to roadsides, churchyards and areas of public amenity, the often considerable increase has brought the birds into conflict with villagers. At Christchurch we heard how the fouled footpath to the church porch needed regular cleaning, and elsewhere a number of householders were annoyed by the increase in noise and fouling in their gardens. Some, realising our interest in their garden colony, hoped we were there to cull the birds! Indeed the significant decrease of Rooks noted in the Conington/Fen Drayton area could well have been the result of a concentrated effort by local people to eradicate their colony. Many of the deposed birds appeared to have moved to Swavesey nearby, swamping every suitable site there! Car parks have become one of the Rooks' safe havens, but the increase in numbers has often resulted in those status-symbol cars being whitewashed with their droppings. One well-publicised call for the eradication of the offending rooks, at the Comberton Village College and Meridian Primary School car parks, where cars were regularly splattered, was rejected after a public outcry against such a scheme. However the birds are on dangerous ground when fouling those polished cars. It seems ironic that, after a history of decline, the first real signs of an improvement in their fortunes should sow the seeds for further conflict with their new-found human neighbours.

Roosting numbers compared

As it is likely that different proportions of the Rook population nest annually, one might think it difficult to prove that an overall increase in numbers has occurred. So it is reassuring to report that a check on corvid roosts in Cambridgeshire in the 1995/96 winter also showed a substantial increase on counts during the past two decades. One roost, possibly best unnamed for its safety's sake, provided the largest gatherings of Rooks and Jackdaws ever recorded in the vice-county. The assembly was difficult to count because a significant proportion of the birds arrived at dusk from distant south-west Cambridgeshire, where a long-occupied roost site has been abandoned. At the peak period, before sub-roosts became established elsewhere, 25,000 to 30,000 corvids were gathering nightly at this site.

A worrying footnote

Apart from that in the Conington/Fen Drayton area, another decrease noted in 1995 among so much success does seem a little sinister. Barrington has lost its

Table 2: Yearly counts of Rook nests per 10-km square

10-km square	1944/45	1955	1972	1982	1989	1995
31	15	10	0	0	0	0
41	355	63	175	40	86	161
20	683	106	74	15	23	16
30	1009	137	24	0	0	0
40	965	126	205	136	50	52
50	–	–	0	–	0	0
29	123	52	4	0	6	3
39	463	63	27	3	19	45
49	1095	268	53	50	178	209
59	60	40	0	0	0	55
69	–	0	0	0	27	0
38	344	189	56	30	60	100
48	732	508	103	0	33	115
58	323	105	28	23	88	138
68	168	0	3	0	12	0
37	160	85	18	2	2	0
47	1126	355	254	162	136	213
57	608	149	92	76	92	94
67	126	223	125	113	115	232
Fens	8357	2478	1241	650	927	1433
26	623	498	242	97	50	67
36	1340	1517	1189	530	375	543
46	788	719	538	655	681	1096
56	471	373	498	207	92	76
66	55	928	1357	635	719	1477
76	–	–	38	25	0	0
25	660	330	440	498	213	299
35	1086	789	680	617	672	686
45	1874	1079	713	477	268	260
55	255	207	162	48	21	189
65	150	461	326	144	127	497
75	–	–	0	0	0	0
24	644	492	88	83	0	13
34	1292	993	790	400	351	414
44	551	567	791	286	269	314
54	869	426	646	209	247	168
64	284	333	388	248	38	194
23	–	–	87	97	109	148
33	–	–	65	79	68	147
43	–	–	40	60	0	0
S. Cambs	10942	9771	9078	5355	4240	6588
Totals	**19299+**	**12255**	**10319**	**6005**	**5167**	**8011**

long-standing rookery and numbers nearby have been reduced. One cannot but relate this to local people's concern at the burning of factory waste at the cement works there. It may be just coincidence and the decrease may antedate the burning; however it would be a high-flying species like the Rook that would act as an early warning indicator of pollution from this tall chimney emission. Birds have certainly brought attention to dangerous contamination in our environment in the past.

Acknowledgements

My thanks go to Mr A.E. Vine for his coverage of Fortrey Hall and to Mrs R. Warrilow for her help during the 1995 survey and her typing of this article.

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Rookery **Graham Easy**

Two annual crane's-bills in Cambridge streets and gardens

Philip Oswald

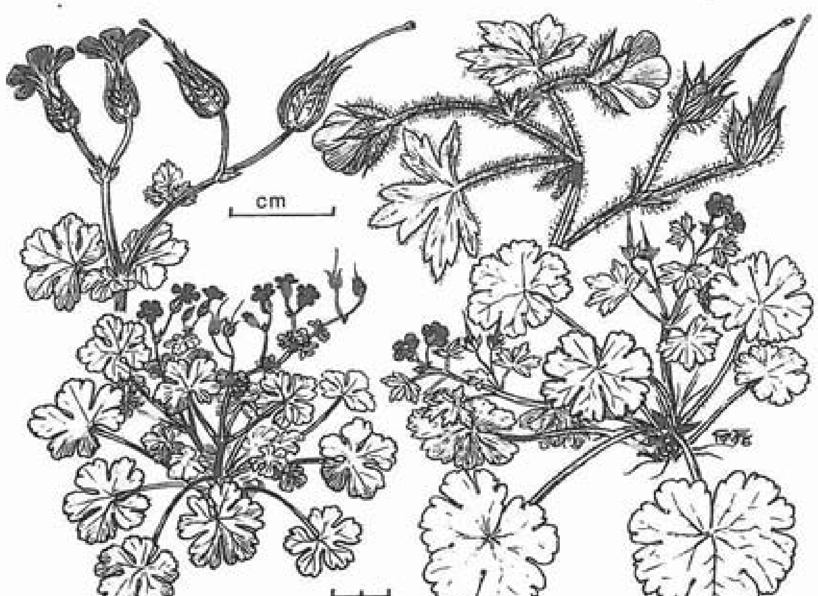
Shortly before we moved from Shrewsbury to Cambridge 20 years ago at the end of the long, hot summer of 1976, I noticed from my car as I drove along a road not very far from our house an unfamiliar-looking crane's-bill growing in the crack between the pavement and a garden wall. I was unable to stop immediately and, by the time I returned on foot in the cool of the evening, a tidy-minded resident had already weeded out the offending rosette! That might have been the end of the matter, but, as I looked at the sign naming the road, Luciefelde Road, suddenly an association struck my mind: William Allport Leighton, a student of Professor John Stevens Henslow and an undergraduate contemporary of Charles Darwin and Charles Cardale Babington at Cambridge, had lived at Luciefelde House and had recorded in *A Flora of Shropshire* in 1841 (p. 333) that Round-leaved Crane's-bill *Geranium rotundifolium*, not otherwise a Shropshire plant, was "completely naturalized in my garden near Shrewsbury, where it is now a troublesome weed, from seeds taken from a specimen from Bath".

Round-leaved Crane's-bill is quite similar to the well-known Dove's-foot Crane's-bill *G. molle*, but it is less obviously hairy, the 5–9-lobed leaves are kidney-shaped, *not* round as its name suggests, and the pale pink petals are rounded, not notched. A search of the vicinity revealed an established population of this plant in a grassy patch across the road, and later, with the permission of the current occupant, I found it still growing as a weed in the much curtailed garden of Luciefelde House itself. A Wild Flower Society member, Mrs Dorothy Evans, had recorded this species a few years previously in nearby Longden Road, but her record had been treated as doubtful!

When I came to Cambridge, I found that *Geranium rotundifolium*, though first recorded in Cambs by Israel Lyons (1763, p. 44), was considered rare in the county (Perring *et al.*, 1964, p. 90) and indeed was thought by Babington (1860, pp. 46–47 and 314) to be extinct. But, when I visited the Botanic Garden, I was interested to find that it was a common weed there, particularly near 1 Brookside, then the Garden Office, where there was a label for it (TL 45235730), and in the Systematic Beds, where it was grown 'officially' (45325707). It usually comes into flower towards the end of April, but I soon learnt to recognise it even in winter and noticed a useful character not mentioned in most floras, though observed (I find as I write this) by Leighton – a small red spot at the base of each sinus of the rosette leaves. (I have seen these spots on plants of *G. rotundifolium* in France, Portugal, Greece and Cyprus too, but disconcertingly I have found them also on the rosette leaves of *G. molle* at Welches Dam.)

I started to look for the plant in the streets and front gardens near the Botanic Garden and have found it, for example, in the gardens of St Mary's in Bateman Street (45305732) and of 12 Panton Street (45295757) and near the telephone box at the north end of Francis Passage (45445744). Until a few years ago it also grew as far from the Garden as the car park by Downing College's kitchen gate in Tennis Court Road (45175785), but it has not survived the tarmacking of the previously unconsolidated surface. On 1 May this year I found it in full flower in Millington Road (44125738). The only other place where I have seen this species in Cambs is on the western edge, grading into a garden, of the motte south of Ely Cathedral (540799), where it was flowering on 26 July 1993. However, Graham Easy tells me that he has found it frequently near railway tracks in and near Cambridge (see also Crompton & Whitehouse, 1983, p. 30) and Dr Max Walters has recorded it in Grantchester.

My interest in another annual crane's-bill as a garden 'weed' goes back over 40 years, to 1952, when as an undergraduate I found Shining Crane's-bill *Geranium lucidum* already flowering on 20 April on a wall in the garden of the Old Rectory in Fen Ditton (482603). This species, though not common in Cambs, has a long history here, having been recorded by John Ray in 1660 "*On the bank and in the hedge on the right hand of the lane leading from Cambridge to Chesterton plentifully*". Babington (1860, p. 47) gives its habitat as "Rather damp but exposed banks" and, besides Wisbech, lists three localities around Cambridge, on Midsummer Common, near the footpath to Chesterton church, and at Quy. I recorded it from the garden in Fen Ditton in May of the next two years, 1953 and 1954, but I did not see it again in a garden till I was living in Shrewsbury, where in about 1972 it covered a small front garden in Drawwell Street in Belle Vue, near where we lived (Sinker *et al.*, 1985, p. 204).



Round-leaved Crane's-bill *Geranium rotundifolium* (right) and Shining Crane's-bill *G. lucidum* (left) **Graham Easy**

Shining Crane's-bill is a neat, attractive plant with glossy, bright green, almost hairless five-lobed leaves which readily colour a fine crimson if the plant is slightly stressed by drought, as it has been this spring. Its flowers, too, have rounded petals but of a deeper pink than those of Round-leaved Crane's-bill. It is easy to see why it might be admitted to a botanist's garden.

When we came to Cambridge, I soon found that *G. lucidum* was well established and labelled in a shaded border south-east of the glasshouses in the Botanic Garden (45505727). The label has gone now and the population has fluctuated over the years, but it has survived. I also noticed it carpeting the tiny front garden of 3 St Eligius Street (45295745). Scilla and Philip Hall, into whose garden at 42 Panton Street (45315746) it has spread, tell me that it was brought here in the late 1970s by Kathy McVitie from Hildersham, where it was described by Perring *et al.* (1964, p. 90) as "plentiful on a roadside bank"; Gigi Crompton says that it was first recorded there by T.G. Tutin in 1929 and that it still flourishes (547489). *G. lucidum* is now abundant around the junction of St Eligius Street and Coronation Street.

About eight years ago Bridget Smith, a colleague of mine in the Nature Conservancy Council, gave me a couple of plants of Shining Crane's-bill from her garden near St Ives (v.c. 31), imported in the early 1980s from Margaret Palmer's garden in Barnack (v.c. 32, where it is presumably native on the Oolite). Within two years it had almost taken over our front garden (45325752), but it has since decreased, skipped the next garden and carpeted that of 37 Panton Street. So there are now two populations of different origins within a few metres.

On 14 November 1995 I noticed *Geranium lucidum* lining the edges of the southern half of the footpath linking Porson Road and Rutherford Road, just north of Long Road (45405584). Then, on 6 April this year, I saw it in Dr Oliver Rackham's front garden in Grantchester Street, Newnham (44355720). He says that a single plant appeared in his father's garden in Norwich in 1983 (possibly from Flatford or even Crete) and he brought some to Cambridge.

William Leighton's record of his action in the 1830s enabled me to explain the presence of an improbable plant in a Shrewsbury street nearly a century and a half later. Perhaps Cambridge botanists of the mid 22nd century will be interested to learn how two of their street and garden weeds originated. I hope they will be able to interpret my grid references!

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Barn Owl pellets – a practical insight into nocturnal life for Cambridgeshire schoolchildren

G. Alan Revill

It has been said many times that we are all experts in child education. We have, after all, been through the system, or a system, for at least 10 to 15 years each. Given the chance, children are very practical; but then I hear, "What was good enough for me is good enough for my children." I got quite a good, thorough grounding, but oh! it was so dull. Charlie Greensides was the only teacher I came across willing to risk the Great Outdoors with his class of ten- and eleven-year-olds. That was on the day of the termly nature walk along the banks of a Yorkshire river. He led, we followed; he pointed, we looked. Later, in the VIth form, in what was then Cumberland, I was to be amazed that A-level Physical Geography was achieved completely by following Monkhouse's *Principles of Physical Geography*. A textbook – and yet out of the window I could see the Buttermere mountains and Whinlatter Pass.

Many teachers today favour a different system, using a vast array of approaches in a bid to teach young children in practical ways and in so doing to instil wonder and excitement. I have found it fairly uncommon for one approach to 'hook' a whole class at one go. Even the best story will have one or two fidgeting. Ah, but hold fast: bring out the big guns – a packet of fenland Barn Owl pellets.

Noses wrinkle, the children's thoughts turn to droppings and other earthy subjects. We talk about the night and things that frighten them, the unknown, the unseen, the unfamiliar. Stories and anecdotes are told and shared, a list of nature's night-shift is made, a preserved Barn Owl is studied closely to find out what adaptations and skills it has in order to make it such a supreme hunter of the night. Another owl pellet workshop is underway.

One Barn Owl pellet, containing the skeletal remains of local rodents, insectivores, beetles and birds has the ability to 'hook' two children for anything between two hours and a whole school day. It doesn't end there because the work forms clear links with other areas of the curriculum.

I was working with a class of six-year-olds for six half-day sessions, beginning with a looking/finding walk around a local nature reserve. We found tracks, animal signs, and under the ivy-covered Hawthorns six grey Tawny Owl pellets. Session two saw us dissecting these and the local Barn Owl pellets, finding the prey species, sorting and classifying the bones, using dental charts to find the differences between the Wood Mouse and the Short-tailed Vole, mounting the bones, labelling them and finally sending a letter and chart of the finds to the farm where the pellets were found to give insight into the nightlife there. During session three we worked on skeletal forms, both human and those of other mammals, and made comparisons between structures, using the Upware Field Studies Centre's 'bone library' and x-rays brought in by a child's father who worked at the local hospital. Session four saw us building and testing skeletal structures, using paper, straws and card, and we finally ended with the story of the Tay Bridge disaster, enhanced by the children's dramatic enactment of how the planners and testers got it wrong.

Thousands of Cambridgeshire schoolchildren, some as young as four, have now learned of the local Barn Owls through their pellets. Give them some cocktail sticks, a pair of tweezers, a hand lens, a chart or two and a dampened pellet (to stop the fur content infesting the atmosphere) and away they go.

We don't always credit or even realise the abilities of young children. We tend to have fairly low expectations. I expected the four- and five-year-olds to concentrate for perhaps twenty minutes and then make a bee-line for the Lego and sand tray. I didn't expect them to cope with tweezers and tiny bones, expecting their manipulative skills to be low, and I thought they would struggle with matching, comparing and sorting. Not a bit of it! They asked questions too – lots of them. Why were Barn Owls endangered? What happened to the preserved Barn Owl and what was it stuffed with? Why were there so many vole and shrew remains, and what defence systems do these prey creatures have? Playtime comes and goes, and 90% carry on oblivious.

Every so often there is that special time when something unusual turns up in a pellet. There is great excitement because it is not on the list or chart – frog remains, a bat's jaw bone, the ring from a small bird's leg, and once – the jawbone of a weasel. Sometimes the children want to compare pellets from different species. They quickly notice how many shiny black beetles' wing-cases there are in Little Owl pellets, how many more bird remains there are in Tawny Owl pellets, and how lacking in bone content are pellets from raptors.

A Barn Owl swooping on a Wood Mouse **Graham Easy**

Collecting large quantities of Barn Owl pellets can be a problem, especially as this species has Schedule One protection status. Some of the roosts are particularly unsafe. I sleep better now that one very tall fenland ruin has been salvaged and converted into a house. Its wormy, green-slimed roofing joists were a nightmare to negotiate, especially when, two storeys below, the brick floor showed through gaps in the lath-and-plaster ceilings.

I have visited many fenland farms and talked to farmers and farmworkers, who are, one and all, proud of the fact that the white owls fly on their land. It is viewed as an honour. Not only that, but they cite evidence of other owls and raptors. They tell of sad occurrences and sometimes fatalities – of owls locked in grain and potato stores or caught in combine harvester grills or drowned in water-butts. Mostly they see the corpses on the roads as they make their early-morning trips to work.

One farmworker, on a so-called fen prairie farm near Upware, is rather fed up with 'bloomin' conservationists' and that all-too-glib term they use – prairie. He says, "We've got all five British owls on this farm at some point in the year, and three of them breed. Now you tell me: if things weren't right out here, would that be happening?" I tell that little anecdote to children working with food chains and simple ecology webs. It serves to underline our work.

Fifteen years on and the owl workshops continue. Supplies of pellets are sent to the local teacher training college and, when the students graduate and move to the corners of the British Isles, in come the orders. They have been sent as far as Hong Kong and Istanbul. The Work Experience unit followed a simple design of mine and constructed light Tri-wall Barn owl-boxes. These are heavy-duty cardboard boxes for internal positioning in outbuildings and tractor sheds. The first success came two years ago when a winter roost for a single bird in an old brick shed was turned into a breeding site.

This fascinating work is not static. It grows, and children's awareness with it. An eight-year-old girl in a village school pointed to the map in her owl booklet. The caption read "Barn Owl – the widest spread land bird." She said, "I wonder if there's a girl in that country" (pointing to the vicinity of Peru) "dissecting an owl pellet just like me. I wonder if she's enjoying it and finding the same kind of bones." I'm glad I overheard that because it set me thinking of ways of learning and teaching through commonalities, crossing cultural and continental boundaries.

In the meantime a colleague teaching at a Naturskolan in Sweden had visited Upware, taken booklets and pellets back, and published a lovely article about what was going on in England. I didn't realise at the time that their school-based environmental education and the Naturskolan network had been largely modelled on the English system and that they had only really made headway in the early 1980s. As a result I was invited to lead sessions in Gothenburg schools, concentrating on Barn Owls to highlight the birds' poor status in that country. There was at the time only one pair breeding near Malmö in the south-east. It was a valuable experience and will be even more so when the promised Eagle Owl pellets arrive. The odd packet of Barn Owl pellets, heat-treated and complete with its green customs declaration form, still finds its way from the Fens to far distant countries. (I often wonder if the customs officials dissect one or two just to make sure that *Tyto alba* hasn't been force-fed with something a little more potent than Common Shrew.)

Dissecting a Barn Owl pellet, with skulls of a. shrew, b. vole, c. mouse, and d. bunting or finch, e. foot of starling or thrush, and f. skull of rat
Graham Easy

I sometimes liken the skills, the presentations of teachers, to a magic fishing-tackle box. It is packed with all sorts of lures, flies and hooks. It is rare for one lure to be cast out and taken by a whole class of children, so we change tackle and present another bait and others are hooked. Perhaps we then have to change tackle again and even adopt new tactics. You may have gathered by now that an owl pellet is one of my best lures. That little, damp, ugly black package contains bones but so very much more.

I'm working on a new lure now. One of the most magical of stories – which still stuns me whenever I see the first Sand Martin down at Upware Locks or hear the first Chiffchaff in March – is migration. Back all those years to Charlie Greensides. I joined the queue to his desk for him to 'roller' my exercise book with a world map. Half an hour later we'd covered the maps with coloured arrows and labelled them "Arctic Tern", "Swallow", "Swift" and "Fieldfare". That was it: half an hour in the whole of my school life. Not good enough! Back to the tackle box and the drawing board!

Alan Revill is Teacher-in-Charge of the Cambridgeshire L.E.A. Field Studies Centre, Upware.

Professor Paul W. Richards CBE (1908–1995)

I first met Paul Richards when I was a first-year student in the University Botany School in the autumn of 1936. I remember that he took me to the herbarium and showed me how moss specimens are kept. I was already interested in mosses, having had H.N. Dixon's *Student's Handbook* put in Gloucester Public Library so that I could borrow it. I recall the surprise at finding that Paul is mentioned in this book for having discovered the aquatic moss *Octodiceras fontanum* growing in the river at Henley-on-Thames. The surprise was that such a youthful-looking member of the Botany School staff should be mentioned in a book published in 1924.

In 1938 Paul Richards began a series of excursions that are continued to this day to local sites of particular bryological interest. I joined these excursions, along with many other students. They were held on Saturday afternoons in the Lent Term and were to the same places each year – Little Widgham Wood, the Fleam Dyke and Icklingham Warren. The excursions were planned with the object of teaching students how to recognise the common mosses. Paul used to give out a sheet listing the common species to be expected at each locality. I remember the excitement of finding new vice-county records on these excursions – *Leucobryum glaucum*, in an old coppiced stump (an unusual habitat) in Little Widgham Wood and still the only Cambridgeshire find of this calcifuge species, and *Weissia sterilis*, in the chalk grassland of the Fleam Dyke.

In 1988, on the occasion the 50th anniversary of the first of these bryological excursions, we tried to repeat the original outings, visiting Little Widgham Wood in particular. Wendy Stevenson produced an iced cake with an appropriate legend and Paul cut it. An account of the excursions, which Paul and I wrote, appeared in *Nature in Cambridgeshire* that year (No. 30: 41–49, with photographs on the inside back cover). The account was reprinted the following year in *Bulletin of the British Bryological Society*, No. 55: 39–47.

One excursion deserves special mention as it was deeply etched in our memories. It was that to Little Widgham Wood on 1 March 1941, and a combination of two events was involved: first, the bus we had hired to take us to the wood broke down shortly after we started the return journey and we had to walk to Dullingham station to catch a train back to Cambridge; and, secondly, a German bomber dropped a series of bombs on Newmarket that day, one of which hit the telephone exchange. In consequence, it was impossible for Paul to telephone Anne to tell her that we would be late back. This was the more worrying for Anne because, for the first time, their daughter Catherine had joined the excursion.

Paul kept a loose-leaf file in which Cambridgeshire bryophyte records were kept, and it was with Paul's encouragement that Michael Proctor published 'A Bryophyte Flora of Cambridgeshire' in 1956 (*Transactions of the British Bryological Society*, **3**: 1–49).

As a student I was constantly asking Paul for his help in identifying mosses. In the summer of 1938 I went to Norway and found a moss that Paul had never seen before – *Trematodon ambiguus*. He was always most willing to give his time in helping students. He organised field trips in the Easter Vacation, for example to the Lake District in 1940. We worked on individual projects and gave talks at Paul's house, on our return to Cambridge, about our results. I attended University lectures given by Paul. His lectures on bryophytes gave a modern view about their evolution, quite contrary to that in books available at that time. In effect, he was saying that many relatively simple bryophytes, often adapted to temporary habitats where a shortened life-cycle is advantageous, are not primitive as previously assumed, but secondarily simplified by reduction or loss of features of allied species.

It was as a direct result of Paul's friendship with W.E. Nicholson that the latter's priceless collection of bryophytes came to the University herbarium (**CGE**) on Nicholson's death in 1945. These specimens have greatly enhanced the usefulness of the collection, as they are reliably identified. At the same time the Department benefited from the gift of Nicholson's diaries, which give a detailed picture of his botanical excursions in Sussex, Cornwall and elsewhere in Britain and on the continent.

Paul had links with Wicken Fen extending over some 65 years. He had made some of the first finds there of bryophytes when he was an undergraduate at Cambridge in 1928–1930. These finds included *Climacium dendroides*, a curiously rare plant in Cambridgeshire though frequent in the Breckland. It was not refound at Wicken until 1979. Paul was a member of the Wicken Fen Local Advisory Panel, where his knowledge of plant ecology and experience of conservation were of great value.

My overall impression of Paul was of a dedicated teacher with an immense knowledge of bryophytes. That he was also a world authority on tropical rainforests I did not discover until later. I am sure that his teaching, both in the laboratory and particularly in the field, has provided an example which many generations of students have followed.

On 6 August 1994 I took Paul on what was to be his last field trip. We went to Fowlmere and visited the newly-discovered *Lythrum hyssopifolia* sites there. These have a rich flora of ephemeral bryophytes. He was particularly interested to see *Phascum floerkeanum* and three species of *Riccia*. The very next day he fell in his garden and broke his leg.

Harold Whitehouse

Some uncommon algae from Cambridgeshire waters

Hilary Belcher & Erica Swale

It is often remarked how many ponds have disappeared from the landscape, but the very considerable number remaining seem to be almost totally neglected by naturalists. There is no directory of local ponds except for one the writers have started for their own use. Our interest is in the algae living in these ponds and also in rivers. Freshwater algae are neglected in Cambridgeshire. Unlike higher plants, there is no distribution scheme for them and, except for the diatoms, no checklist. A national algal flora is now planned, so more work is urgently needed.

Cambridgeshire is more fortunate than most counties in having a vice-county list of algae, compiled by E.A. George in the 1960s and 1970s, consisting of a card index now in the School of Plant Sciences. It is based on the two floras of G.S. West (1899, 1911), with George's own and other records. This list is now on our computer, where we have tried to bring the nomenclature up to date. Our own records are being added. We have also prepared a full list for Wicken Fen, to be published in a forthcoming book (Friday, in press).

We have been looking at collections of algae from local ponds and rivers and have found a number of species not on the Cambridgeshire list; several of these are depicted below. They were identified by means of the excellent floras (in German) from central Europe, where the study of freshwater algae seems to be taken more seriously than it is in Britain, possibly partly as a consequence of people's interest in the ponds connected with freshwater fish culture.

Many common algae may be found in any pond, but water-bodies seem often to have their own characteristic mixture of species, somewhat analogous to island floras. The first place to search for a particular uncommon alga is where it was previously recorded, even if that was several years ago. The least rewarding pools are those covered with duckweed (*Lemna* spp.) or frequented by many waterfowl. Any pond may present surprises, for instance that on the traffic island at the intersection of the Huntingdon Road (A14) and the road from Oakington to Dry Drayton (TL 396629). In December 1955 this dark reedmace-fringed pool contained a thriving population of the tiny green motile algae *Spermatozopsis exsultans* (Figure 1C) and *Scourfieldia complanata* (Figures 1A, 1B), the former once recorded in the vice-county and the latter never recorded, and such interesting finds are not uncommon. Study of the freshwater algae is heartily recommended to amateur microscopists, and we would be prepared to help anyone who takes up the challenge.

Figures 1D–R depict some other unusual species collected locally. They are certainly new to Cambridgeshire. Whether they are new to the British Isles we do not know, owing to the lack of a national recording system.

Figures 1A, 1B: *Scourfieldia complanata* G.S. West, x 2000 (probably Chlorophyta, Volvocales) (Huber-Pestalozzi, 1961, p. 64, Figure 50D)

We have seen this tiny green motile alga (or flagellate) in three ponds in Cambridgeshire, and last December it was present in considerable numbers in the pond near Dry Drayton mentioned above (TL 396629). It was not in George's Cambridgeshire algal list, probably having escaped notice by its small size (3–4.5 μm in diameter) and by its tendency to appear in the winter months. The lenticular cells have two slightly unequal flagella each about twice as long as the cell.

Figure 1C: *Spermatozopsis exsultans* Korshikov, x 2000 (probably Chlorophyta, Volvocales) (Huber-Pestalozzi, 1961, p. 36, Figure 25)

These tiny green banana-shaped flagellates may have two or four flagella and swim rapidly in spirals. Again, they have probably been overlooked owing to their small size (up to 12 μm long). This species has been recorded once only for the vice-county, by M.R. Droop, from the ditch on Queens' Green, Cambridge, a backwater of the River Cam (TL 446582), where we have also found it. It was common in the pond near Dry Drayton in December 1995 but absent by the next month (as it forms cysts which sink to the bottom), when we realised we needed a picture. The cell illustrated is therefore from Tewitfield, Lancashire.

Figure 1D: *Sphaerellopsis fluviatilis* (Stein) Pascher, x 2000 (Chlorophyta, Volvocales) (Huber-Pestalozzi, 1961, p. 450, Figure 620), from a garden pond in Girton (TL 425616) in April 1995

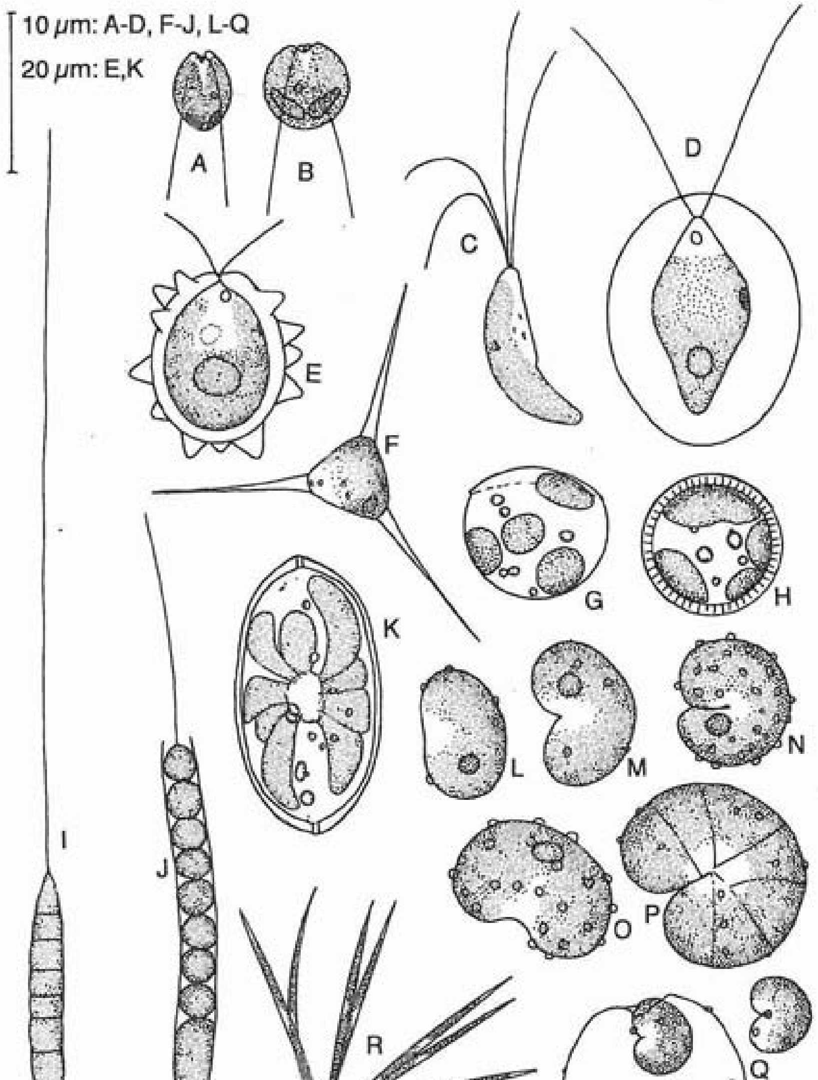
Numbers of this flagellate were found in the plankton of this pond, a new record for Cambridgeshire. Each has a large ellipsoidal envelope surrounding a biflagellate *Chlamydomonas*-like cell. Garden ponds in south Cambridgeshire, such as the one concerned, generally have a neutral to alkaline pH, whereas previous European records for this flagellate have been from acidic bog pools.

Figure 1E: *Lobomonas gracilis* Christen, x 1000 (Chlorophyta, Volvocales) (Huber-Pestalozzi, 1961, p. 319, Figure 736), from the plankton of the River Cam in Cambridge (TL 447590), August 1976, a new vice-county record

As in *Sphaerellopsis*, the *Chlamydomonas*-type cells are each enclosed in a wide transparent envelope, but in *Lobomonas* this is produced into a number of lobes or blunt spines. Our cells were rather larger than Christen's but otherwise very similar.

Figure 1F: *Treubaria triappendiculata* Bernard, x 2000 (Chlorophyta, Chlorococcales) (Komárek & Fott, 1983, pp. 266–267), from the Thames (as we have no drawing of Cambridgeshire material)

Figure 1 (opposite): A, B: *Scourfieldia complanata*, x 2000; C: *Spermatozopsis exsultans*, x 2000; D: *Sphaerellopsis fluviatilis*, x 2000; E: *Lobomonas gracilis*, x 1000; F: *Treubaria triappendiculata*, x 2000; G, H: unidentified floating alga, x 2000; I, J: *Clastidium setigerum*, x 2000; K: *Neglectella asterifera*, x 1000; L–Q: *Juranyiella javorkae*, x 2000; R: *Podohedra falcata*, x 2000



10 µm: A-D, F-J, L-Q
20 µm: E,K
A
B
C
D
E
F
G
H
I
J
K
L
M
N
O
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R

This alga has cells which are approximately triangular in outline when seen on a slide, with a cup-shaped parietal chloroplast and, in younger cells, a single pyrenoid. From the rounded corners of the cell project long tapering processes which are so transparent that they are very difficult to see. This is probably the reason that this species is unrecorded for Cambridgeshire, even though it is not uncommon. We have found it in the River Cam in Cambridge (TL 447590), in the Great Ouse and in three ponds.

Figures 1G, 1H: An unidentified unicellular alga living at the surface film of water, to which it adheres by the hydrophobic (water-repellant) upper part of its cell wall, as shown in Figure 1G (x 2000). It was seen as iridescent films on the surface of two buckets of rainwater in Girton (TL 424616) during December 1994, November 1995 and January 1996. In its non-reproductive state it is normally spherical and thin-walled, but it can form thick-walled cysts with radially striated walls (Figure 1H).

This alga bears a strong resemblance in its life style and appearance to *Nautococcus cordatus* Korshikov (Chlorophyta, Chlorococcales) (Fott, 1972, pp. 82–83, Figure 95), but, instead of a central chloroplast with a pyrenoid, it possesses several peripheral chloroplasts and no pyrenoids. This fact, together with the presence of several oil globules, hints at a relationship to the Xanthophyta, but we have been unable to find references to anything resembling it in the monographs on this group by Ettl (1978) and Pascher (1939) or those on the Chlorophyta by Fott (1972) and Komárek & Fott (1983). We propose to investigate this species further.

Figures 1I, 1J: *Clastidium setigerum* Kirchner, x 2000 (Cyanophyta, Chamaesiphonales) (Geitler, 1932, p. 409)

This blue-green alga occurred in small numbers, along with other epiphytes, on the filamentous green alga *Cladophora* in the pond of The Crescent, Storey's Way, Cambridge (TL 437592). The cigar-shaped cell is attached at one end to the wall of the host, while the other bears a long fine thread, which is difficult to see. When mature the cell breaks up into a number of spherical spores, as shown. This species has not been recorded from Cambridgeshire, probably owing to its small size.

Figure 1K: *Neglectella asterifera* (Skuja) Fott, x 1000 (Chlorophyta, Chlorococcales) (Komárek & Fott, 1983, pp. 526–528)

Several of these large unicells occurred in samples from the pond in the lawn at Madingley Hall (TL 392405). The elliptical cells, up to 32 µm long, have a central pyrenoid from which the lobes of the chloroplast radiate. The cell wall is thick and is perforated by a pore at each end. This species has not been recorded from Cambridgeshire. Komárek & Fott (1983) give its distribution as the Tyrol and Lapland.

Figure 1L–Q: *Juranyiella javorkae* (Hortob.) Hortob., x 2000 (Chlorophyta, Chlorococcales) (Komárek & Fott, 1983, pp. 542–544)

Cells of this species were found in samples from Prince Albert's pond at Madingley Hall (TL 391402) during 1995. They are reniform (kidney-shaped), each with a parietal chloroplast and a single pyrenoid. The cell wall is bedecked with irregularly distributed warts, variable in number and present even in the youngest cells. Figures 1P and 1Q are the same dividing cell 12 hours apart. Young cells formed by the division of the mother protoplast (1P) are released through a tear in the convex side of the wall (1Q).

This alga is new to Cambridgeshire. Komárek & Fott (1983) give its known distribution as France, Czechoslovakia and Hungary.

Figure 1R: *Podohedra falcata* Düringer, x 2000 (Chlorophyta, Chlorococcales) (Komárek & Fott, 1983, pp. 618, 620)

This epiphytic alga was collected in the pond of The Crescent, Storey's Way, Cambridge (TL 437592), in 1994 and 1995. The cells were attached to the wall of *Cladophora* by one end and were long and thin, like some species of *Ankistrodesmus*, about 30–35 x 2 µm. They are acutely tapered at the ends and have a chloroplast which occupies almost the whole length of the cell, but with no pyrenoid, again resembling that of *Ankistrodesmus*. The mucilage by which they are attached to the host could not be seen.

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Vascular plant records

G. Crompton & C.D. Preston

Plants and botanists may have wilted during the long hot summer and drought, but for some plants this was an exceptionally good year. The Lizard Orchid *Himantoglossum hircinum* increased from 150 flowering plants in 1994 to 250 in 1995. This sharp increase is particularly noteworthy because in the early 1980s we never had even 50 flowering plants. Despite the large number of flowering spikes in 1995, many individual flowers aborted or failed to set seed.

There were many records of Bee Orchids *Ophrys apifera* occurring in greater numbers than usual and in a variety of new sites. Knapweed Broomrape *Orobanche elatior* continues to thrive in the south of the county: 227 spikes were counted on a roadside at Litlington, and there was a very large number of Common Broomrape *Orobanche minor* on a slip-road near Six Mile Bottom. Ploughman's-spikenard *Inula conyzae*, once rare in the vice-county, has been found in 13 new sites and four new 10-km squares during the past three years. Frogbit *Hydrocharis morsus-ranae*, which according to the textbooks rarely if ever fruits in this country, fruited freely at the Nene Washes, although not in Swavesey. Even Spiked Speedwell *Veronica spicata*, which as usual wilted in the dry weather, completely recovered after a few days' rain in September and flowered beautifully. Only Grass-poly *Lythrum hyssopifolia*, which was expected to flourish after the heavy rainfall in January and February, had to struggle under the lush growth of other plants and, although present, was difficult to find.

The winters of 1994/95 and 1995/96 were set aside for the BSBI Mistletoe Survey, and we congratulate Olwyn Peacock on her survey of Cottenham – over 86 clumps on eight different hosts scattered over 38 localities in the parish.

The new 'Atlas 2000' project was launched at the end of 1995, and four years of fieldwork start this spring. This national mapping scheme provides a splendid chance to learn plant identification (as one of us – G.C. – did for the earlier *Atlas of the British Flora* project in the 1950s). We particularly need people to record the commoner species. Anyone wishing to help should get in touch with Derek Wells (14 Tithe Close, Hilton, Huntingdon, PE18 9NR; tel. 01480-830226) immediately. He has record cards, instructions and a booklet which helps with identifying difficult species.

Arabis glabra (L.) Bernh. Roadside bank, north side of West Road, Gamlingay, TL 235520, D.E. Coombe, 25.5.1995. The first record since 1952 at the only locality in the vice-county.

Astragalus danicus Retz. Six flowering heads around a large clump of *Centaurea scabiosa*, roadside verge near Chrishall Grange Plantation, Duxford, TL 453423, G. Crompton & D.A. Wells, 29.5.1995. A new site in v.c. 29 for a declining species.

Atropa belladonna L. Two plants laden with berries in a small front garden in Wisbech (not planted), TF 462095, G.C., 11.10.1995. This is only the third record from Wisbech – not surprisingly, for in the first record in 1597 Gerarde in his *Herball* describes the death of two small boys in less than eight hours from eating the "great round berries . . . the colour of black jet . . . soft and ful of purple juice". He goes on to advise: "Banish therefore these pernicious plants out of your gardens, and all places neere to your houses, where children or women with childe do resort, which do oftentimes long and lust after things most vile and filthie; and much more after a berrie of a bright shining blacke colour, and of such great beautie, as it were able to allure any such to eate thereof . . .."

Chrysosplenium oppositifolium L. A flowering patch measuring 4 x 10 m in a wet hollow along the sides of an old drain near the eastern edge of Ditton Park Wood, TL 672568, S. Leatherdale, 4.1995, and G.C., S. Leatherdale & D.A. Wells, 2.5.1995, CGE. Second vice-county record.

Doronicum x *excelsum* (N.E. Br.) Stace A long-established colony in a copse on the edge of The Hall estate, Six Mile Bottom, Westley Waterless, TL 584572, J.C.A. Rathmell, 6.1987 & 13.4.1995, **CGE**, conf. as cv. 'Harpur Crewe' by D.E. Coombe, 27.4.1995. The first vice-county record of this garden escape.

Euphorbia platyphyllos L. Frequent in a broad band across a set-aside field, Heydon, Cambs but v.c. 19, TL 431407, P.D. Sell, 27.5.1995, **CGE**. A very rare cornfield weed in a new locality.

Geranium x *oxonianum* Yeo One plant at the base of a wall on the south side of Midsummer Common, Cambridge, TL 456581, A.C. Leslie, 7.1995. The first vice-county record of this hybrid; we have no records of one parent, *G. endressii*, and only one of the other, *G. versicolor*, made between 1939 and 1945.

Muscari neglectum Guss. ex Ten. Hills near Cherry Hinton, TL 4--5--, W.L.P. Garnons, 4.5.1825, **SWN**, conf. G.C., 26.2.1996. This record antedates by three years the first record in C.C. Babington's (1860) *Flora of Cambridgeshire*. Babington states that he gathered the species "near Hinton" on 11.4.1828, but he did not know "who first found it, in that or the preceding year".

Myriophyllum aquaticum (Vell. Conc.) Verdc. Several patches with *Lagarosiphon major* at the muddy edge of a pond in a horse-grazed field, Witcham Equestrian Centre, Witcham, TL 457804, C.D.P., 12.11.1995, **CGE**. The third v.c. record of an alien aquatic which is increasing nationally.

Papaver somniferum L. Abundant in a wide band 200 m long bordering a wheat field near Cowbridge, Swaffham Bulbeck, TL 555636, G.C., 21.6.1995. A common casual in fenland gardens and usually present in various colours, but very rarely seen in quantity in a cornfield. All the flowers of the Cowbridge population were mauve with a dark blotch at the base of the petals.

Phleum phleoides (L.) Karsten Newmarket Heath/Devil's Ditch, W.L.P. Garnons, 7.1840, **SWN**, conf. P.J.O. Trist, 8.11.1995. This is the last record from the site where this species was first recorded in Britain, by Israel Lyons *c.* 1760. By 1820 Relhan omitted the site from the third edition of his *Flora Cantabrigiensis*, but might the plant still occur there?

Ranunculus lingua L. Ditch on the east side of the railway line, where Hobson's Conduit passes under the railway, near Nine Wells, Great Shelford, TL 459542, D. Seilly, 1995. A new site for a locally rare species, which was last recorded in this 10-km square before 1930.

Solanum nigrum L. subsp. *schultesii* (Opiz) Wessely About 50 plants in a one-year set-aside field, Hall Close, Bassingbourn, TL 326449, P.D. Sell, 24.9.1995, **CGE**. First vice-county record of this introduced subspecies, which is distinguished by its covering of glandular hairs.

Tilia cordata Miller Coppice stool *c.* 3 m across, with some 35 feet of regrowth, north corner of Ditton Park Wood, TL 662570, S. Leatherdale, 4.7.1995, **CGE**, conf. C.D. Pigott. The stool is estimated to be 300 years old. This is the first record of this species as a native from the east of the vice-county.

Trisetum flavescens (L.) P. Beauv. subsp. *purpurascens* (DC.) Arcangeli The most widespread grass over perhaps 50 acres, Magog Trust site, Stapleford, TL 47-53-, 48-52- & 48-53-, P.D. Sell, 7.1995, **CGE**. The first vice-county record of a subspecies which is native only in the Alps and the Carpathians and is not recorded for Britain in Clive Stace's (1991) *New Flora of the British Isles*. It must have been a constituent of the 'native' seed mixture sown when this site was converted from arable land to grassland, which is now known to have contained numerous alien species and variants (see *Nature in Cambridgeshire*, No. 34: 35–42).

Bryophyte records

C.D. Preston & H.L.K. Whitehouse

Mosses

Dicranum tauricum Sapehin Small scattered tufts on major branches of an old apple tree, 21 Luard Road, Cambridge, TL 460561, R.A. Finch, 20.5.1995. A further record of a species which was first recorded from the vice-county in 1977 and is spreading nationally.

Orthotrichum cupulatum Brid. Cushion with 70 capsules on the vertical side of a concrete coping stone of a pillar, 237 Hills Road, Cambridge, TL 463561, R.A. Finch, 3.6.1995, **Herb. R.A.F.** This record provides further evidence that this species is less rare than was once supposed.

Orthotrichum striatum Hedw. Small tuft with four capsules, bough of an old apple tree, 21 Luard Road, Cambridge, TL 460561, R.A. Finch, 20.5.1995, **BBSUK**, conf. T.L. Blockeel. A new vice-county record and one of the more remarkable of the epiphytes which have been discovered in the vice-county in recent years. It was thought to have disappeared from eastern England because of air pollution, but it now seems to be reinvading, presumably from its strongholds in the west.

Physcomitrella patens (Hedw.) B., S. & G. On the bank of a ditch by a woodland ride, with *Dicranella schreberiana*, *D. varia* and *Fossombronia pusilla*, Lower Wood, Weston Colville, TL 624528, H.L.K.W., 11.11.1995. A scarce species in the vice-county, which typically grows in sites which are flooded in winter.

Rhynchostegiella teesdalei (B., S. & G.) Limpr. Fruiting abundantly in deep shade 0-10 cm above the usual water level and often submerged, on the vertical brick lining of a tunnel by the River Cam under Newnham Mill, Cambridge, TL 445577, R.A. Finch & H.L.K.W., 15.3.1995, **BBSUK**, conf. T.L. Blockeel. This is a new vice-county record of a species which is most frequent on calcareous rocks in northern and western England and North Wales.

Rhynchostegium megapolitanum (Web. & Mohr) B., S. & G. Fruiting well on the vertical side of a large tree stump by path just inside lime plantation, Wandlebury, TL 498531, R.A. Finch, 6.3.1996, **Herb. R.A.F.** This species is rarely recorded in the vice-county, but it is a rather nondescript plant which we may be overlooking.

Liverworts

Fossombronia pusilla (L.) Nees On the bank of a ditch by a woodland ride, with *Dicranella schreberiana*, *D. varia* and *Physcomitrella patens*, Lower Wood, Weston Colville, TL 624528, H.L.K.W., 11.11.1995. This ephemeral species of acidic soils is rare in the vice-county.

Metzgeria fruticulosa (Dicks.) Evans Abundant on the bark of one ash tree, Great Coven's Wood, Weston Colville, TL 62-53-, C.D.P., 11.11.1995. Another new site for this species, which has been recorded with increasing frequency in recent years.

Weather notes for Cambridgeshire 1995

J.W. Clarke

January: Changeable apart from 1st, 2nd and 3rd, when an anticyclone gave three frosty days. Mild and very wet, with 3.47 ins of rain on 17 days, more than twice the average for the month. Daily maximum temperatures about average, minimum 2°F above. Much sunnier than average.
February: Changeable and mild throughout, with only three nights with slight air frost. Wet, with rainfall on 21 days, more than an inch above average. Temperatures above normal, the night minima especially so.
March: Mainly changeable, but with a short settled period in the third week (20th–24th). Heavy rain on 2nd turned to snow overnight, leaving 3 ins of snow lying on 3rd. On 17th gale-force winds caused dust-storms on the black fen soils. Rainfall slightly below average. Temperatures at night much below average and colder than in February. Very sunny, 80% above average.
April: Fine, settled, anticyclonic weather for the first half of the month; changeable in the second half. Very dry, with 0.36 ins of rain, on five days. Temperatures above average. Sunnier than usual.
May: Anticyclonic, fine and warm in the first week, but mainly changeable thereafter. No rain until 16th, then only 1.09 ins, on eight days. Cool to 22nd, with air frost on 14th. Warmer in the last week. Temperatures about average.
June: Changeable, cool and sunless in first half, with fronts running down the North Sea around an anticylone to the west of Scotland. More settled, sunny and warm in second half and becoming hot at the end of the month. Rainfall less than half the average, on 10 days. Temperatures about average.
July: Changeable in the first five days. Thereafter mainly anticyclonic, sunny and hot, with 16 days exceeding 80°F and 91°F reached on 31st. Rainfall below average, on seven days. Maximum temperature 7°F above average.
August: Anticyclonic, sunny and hot to 24th, with two days exceeding 90°F and 16 over 80°F. Changeable in the last week, but remaining very warm with little rain. Total rainfall (0.34 ins) only one seventh of the average, on four days. Daily maximum temperature 8°F above average.
September: Changeable throughout and very wet and cool. Total rainfall (4.25 ins) four times the average, on 18 days. Daily maximum temperature 2°F below average, but minimum 4°F above.

October: Changeable in the first week; mainly anticyclonic thereafter. A dry month, with only 0.44 ins of rain, on four days – less than one fifth of the average. Daily maximum temperature 3°F above average. Daily minimum 8°F above average, but falling markedly at the end of the month to give the first air frost of the autumn on 29th. Much warmer and sunnier than normal.
November: Fine and settled in the first week, with a few slight frosts at night; changeable and mild thereafter. Rainfall half the average, on only 10 days. Temperatures above normal. Sunnier than usual.
December: Changeable until 5th, when an anticyclone over Scandinavia brought freezing winds from the east, with slight snow showers leaving snow lying on 6th. Night frost persisted all day on 10th. Several days with fog night and morning till 12th. Mild and wet to 24th, when another anticyclone brought a return of frost, with the temperature remaining below freezing from 26th to 30th. Fog all day on 27th and 28th, with much hoarfrost on trees and vegetation. Rainfall much above average. Daily maximum temperatures 8°F below average.

Weather records at Swaffham Prior 1995

Temperature °F

Month	*Mean max.*	*Mean min.*	*Highest*	*Lowest*	*Rainfall (ins)*	*Rainfall (rain days)*
January	44.91	36.40	54 on 31st	25 on 3rd	3.47	17
February	48.07	39.96	57 on 11th	31 on 26th & 27th	2.10	21
March	48.22	35.46	62 on 31st	27 on 28th	1.47	16
April	56.50	41.00	66 on 6th	29 on 20th	0.36	5
May	63.71	45.16	79 on 5th	31 on 14th	1.09	8
June	66.67	49.30	87 on 30th	42 on 9th	0.74	10
July	79.45	57.94	91 on 31st	42 on 3rd	1.52	7
August	79.29	56.45	94 on 1st	46 on 30th	0.34	4
September	63.60	52.80	71 on 9th	43 on 28th	4.25	18
October	61.81	50.10	74 on 9th	31 on 29th	0.44	4
November	40.70	50.53	58 on 15th	30 on 17th	0.82	10
December	37.10	31.39	50 on 2nd	15 on 29th	2.50	13
Annual means	57.58°	45.67°		Totals	19.10	133

Number of days over 90°F	3
Number of days over 80°F	35
Number of days over 70°F	74
Number of days with a maximum under 32°F	7
Number of days with a minimum under 32°F	46
Last air frost of the spring	14th May
First air frost of the autumn	29th October
Days with snow lying	2
Days with thunder	6
Days with fog persisting all day	2
Highest temperature	94°F (on 1 August)
Lowest temperature	15°F (on 29 December)

Madingley Wood as Hitler knew it, from an air photograph by an unknown German pilot taken on 31 August 1940 (Planting rows can be seen in D2. In the original, there are traces of ridge-and-furrow in the field north of A2, but no sign of the Iron Age site. Some will remember the group of black poplars north of the Panhandle. United States National Archives: RG373: GX10008/GB1044R/102.) (See pp. 27-54.)