The History and Vegetation of some Cheshire Meres

By Edna M. Lind

Introduction.

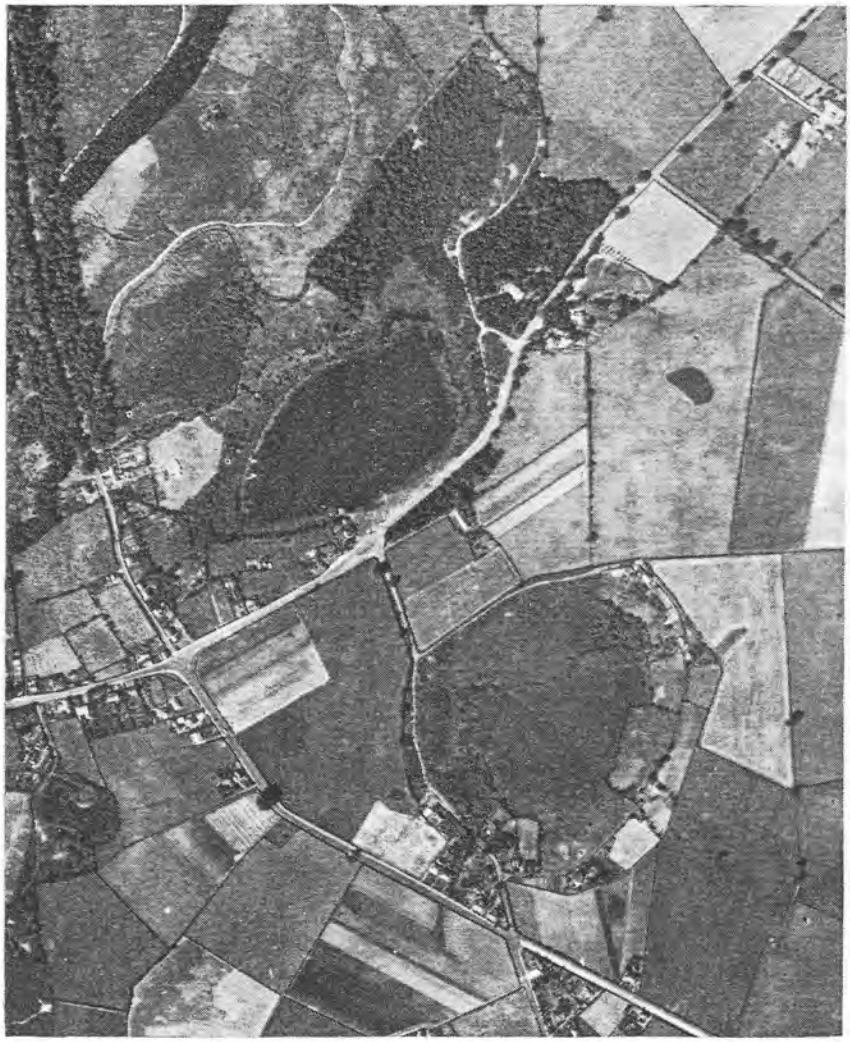
Throughout the countryside of Cheshire are scattered a large number of small lakes and pools and also many peat mosses. Many of the areas bearing the name of mere, such as Blakemere, are no longer sheets of open water but contain extensive tracts of peat moss which no doubt mark the site of former lakes; in others like Flaxmere the filling up process is still incomplete. Among the existing meres some are of the type presented by Rostherne and Redesmere with inflow and outlet and subject to heavy silting, while others like Oakmere have neither inlet nor outlet, are spring fed and have acid water. The process by which these meres may be converted into peat mosses offers an interesting study and can be seen at various stages in different parts of Cheshire.

Hatchmere affords a good example of a small lake of the silted type where terrestrial vegetation is still encroaching on the lake basin. This paper describes the plant communities round the lake shore and attempts to explain the factors underlying the succession which has taken place.

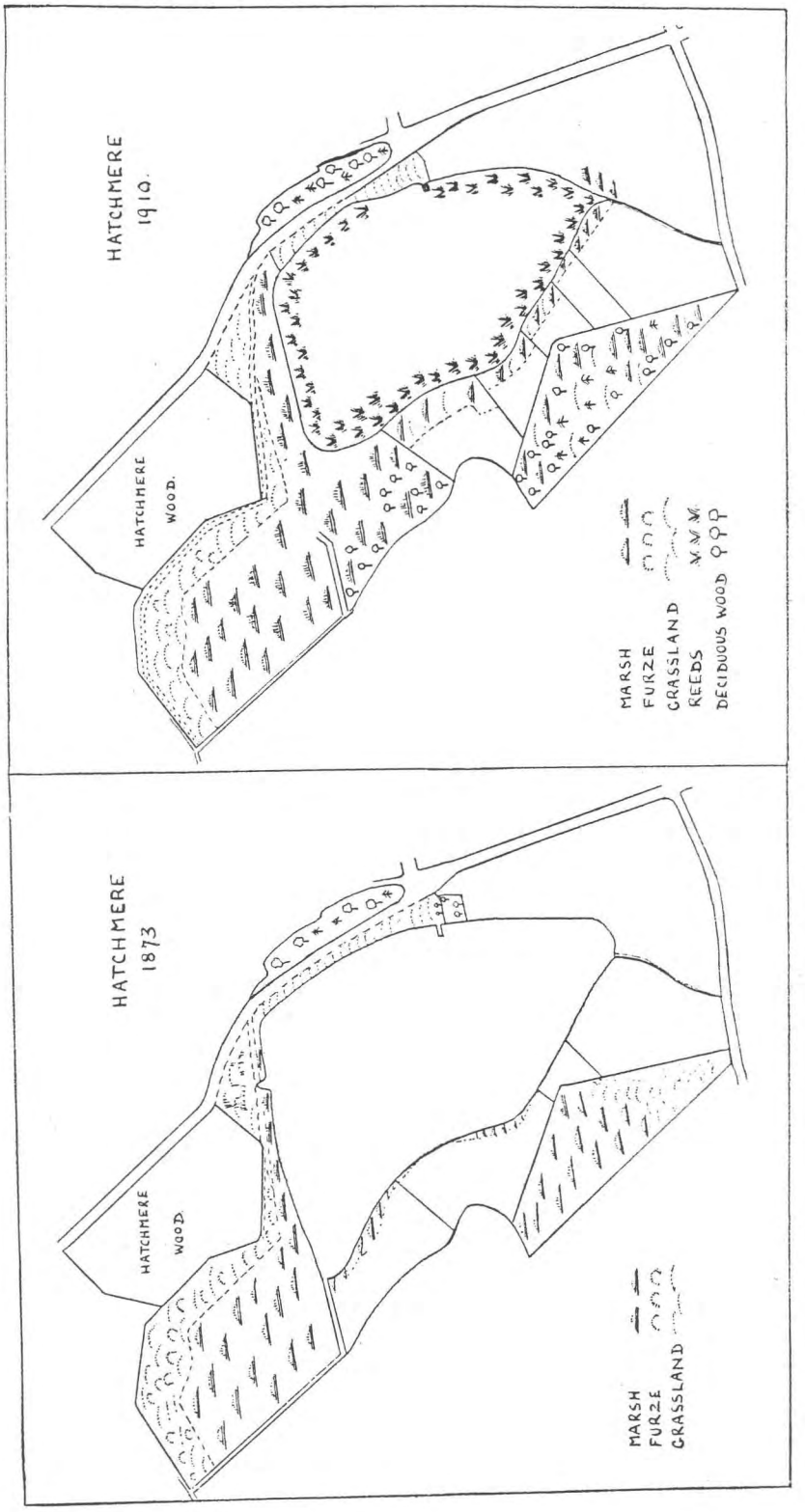
Hatchmere.

Hatchmere lies in Delamere Forest near the village of Norley, and occupies a basin in the glacial drift. The present area of water is about sixteen acres and its depth never more than sixteen feet, but there is evidence that the lake basin was formerly twice this size and is in process of filling up. Though a stream flows out at the south end, the mere is fed only by an artificial channel which collects drainage water from the surrounding fields. Two small drains flow in under the road on the east side and a large drain pipe discharges into the water near the boat house.

Reference to the Ordnance Survey maps of 1873 and 1910 (Page 18) show that significant changes in vegetation took place during these thirty-seven years, particularly in the development of reed swamp at the expense of open water and in the growth



Aerial photograph showing Hatchmere and Flaxmere
(*By permission of the Air Ministry*).


HATCHMERE
1910.
HATCHMERE
WOOD.
MARSH
FURZE
GRASSLAND
REEDS
DECIDUOUS WOOD
HATCHMERE
1873
HATCHMERE
WOOD.
MARSH
FURZE
GRASSLAND

of woodland. Since the 1910 survey there has been considerable further change and the map accompanying this paper records the distribution of plant communities in 1948. Unfortunately camping is allowed on the common land adjoining the mere and this has resulted in injury to the vegetation by fire, trampling and cutting of trees. It is hoped, however, that a survey at a later date may indicate the exact succession of plant communities which is taking place as the lake fills up, especially in the very wet and less frequented part near the water edge.

Description of Plant Communities.

Reference to the map will show that the water is now fringed with reed swamp which is particularly well-developed at the north-west corner. Adjacent to it is a strip of marsh which passes into willow carr abutting either on birch wood or on a large tract of *Molinia-Myrica* bog. The west shore is remarkable for the presence of *Sphagnum-Eriophorum* bog right to the water edge. There has been an attempt at fencing the land on the west bank for grazing purposes, but only the remains of the fences are left and there are no animals there now. Adjoining the west bank is a high outcrop of sandstone bearing *Calluna* and in part planted with pine trees. The south-east end is occupied by houses and cultivated land.

Aquatic Vegetation.

The lake is now under twenty feet in depth at its deepest part and in many parts much shallower. The bottom is covered with organic mud. Along the west shore is a belt of *Nuphar lutea* twenty to thirty feet wide which gives place to *Nymphæa alba* along the north shore. In the shallow water among the lilies and especially at the north end the mud is covered with *Elodea*, while *Sparganium minimum* though present with the *Elodea* is most common on the mud near the outlet end. Dunlop (Dunlop, 1910) describes great masses of *Potamogeton gramineus* washed up near the boat house after a storm. This plant still grows with *Elodea* near the boat house but none came up in the drag from other parts of the mere.

Reedswamp.

Two plants dominate the reed swamp—*Phragmites communis* and *Typha angustifolia*. *Phragmites* is most abundant at the south end and in the north-west corner where it extends through the carr and into the *Molinia* bog. It diminishes gradually along the west shore where it is replaced by *Typha*. *Typha* is found everywhere mixed with *Phragmites* and forms a continuous fringe along its lakeward edge. It is the dominant plant in the water adjacent to the *Sphagnum* bog on the west shore. Other occasional constituents of the reed swamp in the regions of more organic mud are *Eleocharis palustris, Carex rostrata* and *Equisetum limosum*. Associated with the reeds are a number of aquatic and marsh plants. In some parts, where the reed swamp is becoming stabilised and the mud surface is above the summer water level, it is invaded by *Sphagnum* to the exclusion of other bryophytes. Under these conditions the *Phragmites* is less dense and *Hydrocotyle vulgaris, Comarum palustre* and *Dryopteris spinulosa* are frequently found.

Marsh Zone.

Between the dense *Phragmites* of the inner reed swamp and the *Salix* carr is a region which may be designated marsh. The mud surface is in general above the summer water level and the vegetation is characterised by large tufts of *Carex paniculata* with *Phragmites* and a variety of fen and marsh plants. In some parts of the north shore it is this association, rather than true reed swamp which extends right up to the *Typha* fringe. It is quite firm to walk on and in it many young willows and some birches have established themselves.

Salix Carr.

The marsh vegetation passes gradually into a zone of fen with well-developed willow carr. The ground vegetation is dominated by *Carex acutiformis* with *Carex paniculata, Phragmites, Iris* and many marsh plants. The willows form a dense thicket in this very swampy area where the black mud has a *p*H of 6·07.

About ten to twelve yards inwards from the edge of the marsh *Sphagnum* species make their appearance (*S. recurvum*,

S. cymbifolium) and then *Hydrocotyle vulgaris, Molinia* and *Myrica* are added to the flora. Here the soil is drier, more acid (*p*H 4·49) and more highly organic than in the part dominated by the Carices. This more acid type of carr reaches right up to the original lake bank at the north end. Near the bank there are still pools with *Phragmites* and Carices but more generally the ground is drier with *Molinia, Myrica* and *Rubus fruticosus.* It is in the carr on the north shore that the only locality for *Cladium mariscus* is found. During the winter 1944–45 much of the wood was cut along the north-east shore where Oak, Birch, Hawthorn, Rowan and *Frangula alnus* are associated with the willows.

Alnus Carr.

This is confined to the region near the drainage channel in the north-west corner where *Alnus* replaces *Salix* as the dominant tree. *Carex acutiformis* is still the most abundant species of the ground flora but the relative absence of *Phragmites* and the presence, especially near the banks of the stream, of a rich growth of *Phalaris arundinaceæ* distinguishes it from the vegetation of the willow carr. The mud has a *p*H of 6·18 and is less organic than that of the Salix zone. *Sphagnum* has not encroached on this area.

Bog.

The north-west corner of what would appear to be the original lake basin is marked as a " turf pit " in the old maps and is occupied by a peat bog dominated by *Molinia cærula* and *Myrica gale.* The natural condition of this area has been spoiled by peat-cutting, drainage and fire so that it is now covered for the most part by dense tussocks of *Molinia* with *Myrica* scattered fairly widely and *Sphagnum, Menyanthes, Comarum,* etc. persisting in the wet depressions. In some parts, however, a typical bog community is found with *Sphagnum papillosum, Erica tetralix, Narthecium ossifraga, Oxycoccus quadripetala* and *Calluna,* and it is probable that if this area had not been disturbed it might have developed into a raised bog. The *Phragmites* which forms a dense reed swamp at the north-west corner of

the lake extends through the willow carr and into the *Molinia* bog where it is found quite 200 yards from the present water edge.

Where the bog is drying, especially round the edge, a woodland dominated by *Betula pubescens* with *Quercus petræa, Frangula alnus, Pyrus aucuparia* with *Salix* in the damp patches has become established and tree seedlings are plentiful all over the bog.

Two ditches, now partially overgrown, traverse the bog and have a distinct vegetation. *Menyanthes trifoliata* is abundant with *Carex rostrata, C. nigra, C. panicea,* together with *Potamegeton polygonifolius, Comarum palustre, Eriophorum angustifolium* and a number of marsh plants.

Woodland.

There is no doubt from reference to the older maps that all the present woodland is of recent development. The 1873 Ordnance Survey map shows neither willow carr nor birch wood. By 1898, brushwood has appeared on the marshy ground south of the drainage channel and deciduous woodland on the triangular peaty area, also drained, west of the south end of the lake. Even in 1910 no willows are marked ; but deciduous wood has replaced the brushwood, and conifers—planted no doubt—are growing on the triangular area. To-day there is a strip of carr along all but the west shore (where, however, there are scattered willow trees) and well-developed birch wood both north and south of the drainage channel. Stumps of old trees are seen on the triangular area where there is a new covering of birch scrub.

Though the same trees mainly *Betula pubescens, B. pendula, Quercus petræa, Frangula alnus, Sorbus aucuparia,* make up the birch wood in all parts, there is some variation in the ground flora. In the damper part to the south of the drainage channel and adjoining the alder and willow swamp *Molinia* and *Myrica* are dominant while nearer the path on slightly higher ground a more acid type of ground flora is found with rather less *Molinia* and *Myrica* but large patches of *Rubus fruticosus* and *Deschampsia flexuosa* as well as *Vaccinium*

myrtillus and other acid loving plants. In all parts, however, the presence of willow trees and pools with *Sphagnum*, and the continuous cover of *Molinia* and *Myrica* as well as the presence at a depth of five inches of *Sphagnum* peat indicates that this woodland is a recent development on original bog and that it owes its origin to the drying out of the bog consequent upon the cutting of the drainage ditch. The continuation of this process up to the present day has led to the spread of birch over the whole bog where seedlings of oak, buckthorn and also pine are not infrequent.

The West Shore. Grassland.

In the map of 1873, a considerable area along the west shore of the lake is occupied by pasture and arable land with only a narrow strip of marsh along the lake edge. The presence of fences suggests that this area was actually grazed at that time and reached to the water edge at the south end of the mere. This grassland still persists but it is now separated from the open water by a broad band of *Sphagnum* bog and a fringe of *Typha*. The position of the old fences and hedges can still be traced but the land is not grazed and is rather wet and dominated by *Juncus, Carex spp* and *Molinia*. Adjacent to the woodland is a slightly raised knoll with sandy soil bearing a covering of *Deschampsia flexuosa, Holcus mollis, Festuca ovina* and associated plants with patches of *Carex nigra* and *Juncus effusus* and scattered *Betula* seedlings. Passing southward, the *Deschampsia* is replaced by an almost pure stand of casepitose *Molinia* and beyond this the ground becomes wetter with *Juncus spp, Carex spp, Comarum palustre,* etc.

Sphagnum Bog.

The vegetation bordering the west side of the lake presents a striking contrast to the other shores. Opposite the edge of the birch wood, the zone which in other parts is occupied by reed swamp and carr becomes covered by a strip of bog thirty yards wide and extending about 170 yards along the shore. This area is very wet and is dominated by a dense growth of *Sphagnum*

recurvum and *Eriophorum angustifolium*. It reaches almost to the lake edge where a narrow belt of *Carex paniculata* and associated plants separates it from a fringe of pure *Typha angustifolia* with no *Phragmites*. A few willow and birch trees and an occasional pine have established themselves in the bog.

It is possible to stand on the bog quite near the water edge, and digging reveals that the *Sphagnum* cover is not deep but is a relatively recent growth covering a mass of monocotyledon leaves and shoots with *Hypnum giganteum* and other mosses. Beneath this there lies 250 cm. of sub-aquatic peat containing a few plant remains and the shells of many plankton diatoms. *Typha* persists all through the zone extending as much as twenty yards inwards from the lake and it would appear that here again we see an invasion by *Sphagnum* in recent years of an area which was formerly occupied by *Typha* reed swamp.

Roughly opposite the end of the field now under cultivation the *Sphagnum* bog gives place again to reed swamp dominated by *Phragmites*, and *Eriophorum angustifolium* disappears. At first the reed is sparse and has much *Sphagnum* mixed with it but gradually the *Sphagnum* cover goes and is replaced by other mosses. Between here and the outlet the low ground along the lake edge is occupied by dense *Phragmites* with a band of *Carex paniculata* along the inner and outer edges and a considerable growth of *Salix* with some birch and hawthorn. There is still a fringe of *Typha* at the water edge and this plant forms a luxurious growth where the stream flows out and extends up it for about ten yards with some *Equisetum limosum*. The line of an old fence delimits this wet area near the lake from the fields on the adjacent higher land and a number of field weeds have established themselves among the reeds.

Ecological Factors influencing the plant succession.

At Hatchmere there is no evidence either now or in the past of a natural stream of any size feeding the lake, although there is drainage into the mere at several points. The outlet stream appears quite natural and it must be assumed that the lake was originally spring fed. There is evidence from the peat that the area now occupied by *Molinia-Myrica* bog represents a

former extension of the lake basin. It was, perhaps, shallower than the existing mere and filled up long ago at some fall in the water level. Our attention will, however, be mainly confined to the region surrounding the existing mere. The three plant associations—reed swamp, carr and bog, are those which are to be expected round the shores of a lake subject to silting and under fairly damp climatic conditions. Let us examine how far they here represent a natural succession and how far the development of the vegetation has been disturbed by artificial causes.

In 1873 the area of open water was considerably larger than it is now and no reeds or willows grew round the lake margin. At flood times the lake then covered the road along its east shore. Some time prior to this, however, a drainage channel had been cut round the edge of the peat bog and in the 1873 map this is shown entering the lake at its north-west corner. At some time between 1873 and 1898 when the next survey was made, a considerable drop in the water level occurred, probably due to the deepening of the outflow at the south end, and local residents affirm that the level has fallen still further in recent years. These drainage operations have had the effect of exposing round the lake margin new areas of highly organic, water-logged mud upon which vegetation has gradually established itself. The maps of 1898 and 1910 still show no willows though reeds are marked and a considerable area of " marsh " fills the north-west corner. Some notes published by G. A. Dunlop (Dunlop, 1910) describe *Potamogeton polygonifolius* extending from the soft bog into the water with *Comarum palustre* and *Menyanthes trifoliata* as typical plants of the mere margin. Of these plants the first and last are now largely confined to pools and ditches in the peat bog. By 1910 a zone of *Juncus, Typha* and marsh plants including *Ranunculus lingua* and *R. flammula* had been replaced in deeper water by a reed swamp dominated by *Sparganium erectum* and *Equisetum limosum* growing in soft black mud in up to six inches of water. Although it may have been present as a minor constituent of the reed swamp, there is no mention of *Phragmites* which must have reached its present abundance subsequent to 1910.

The presence of *Phragmites* round a lake shore is known to be associated with the deposition of inorganic silt which, at Hatchmere, may have resulted from the cutting of the drainage channel. There is considerable flow along this channel and it receives water charged with silt from the adjacent sandy ground and pasture land. When it was first cut the silt must have been discharged into the open water, but since the drop in the lake level much of it will have been deposited on the marshy area near the mouth of the channel. This would account for the replacement of *Sparganium* and *Typha*, plants of organic mud, by *Phragmites* in the north-west corner. The distribution of the present reed swamp bears out the view that *Phragmites* is associated with the presence of silt; for this plant is abundant not only near the mouth of the channel but near the outflow to which silt might easily be carried by currents, while *Typha angustifolia* replaces it along the east and west shores. *Sparganium ramosum* and *Equisetum limosum* both persist as occasional constituents of the reed swamp association. The mass of *Phragmites* just north of the boat house became detached and was blown across the mere some years ago from the other side.

Typha angustifolia is found in those parts of the lake most remote from silting and also forms a fringe on the lakeward edge of the *Phragmites*. Indeed, in most places the *Phragmites* zone is becoming stabilised and bears a growth of young trees and it is the *Typha* which is advancing into the open water. It may well be that silt is not now reaching the water in any quantity but is being held up by the dense reed swamp and deposited behind it. In this case the mud now collecting on the lake bottom is of a highly organic nature resulting from the decay of aquatic plants and plankton and favourable to the growth of *Typha*.

In that part of the reed swamp remote from the water where the mud surface is generally above the summer water level but is subject to flooding in winter and where the mud still has about 50 per cent. of inorganic matter, marsh plants and *Carices* dominate the ground flora and willow trees form a dense carr with *Frangula alnus* and occasional birch and rowan. In areas totally removed from the effect of silting and flooding, an acid ground vegetation dominated by *Sphagnum recurvum* and

Sphagnum cymbifolium is replacing the sedges and marsh plants while birch and oak are frequent among the willows. Here also, *Molinia* and *Myrica* are well established and it seems probable that the next stage in the succession would be the disappearance of willow with increasing acidity (many of the willows are already dead or dying) and the replacement of the carr by *Molinia* bog. The present bog occupying the old basin may have originated in this way.

One result of the partial blocking of the drainage channel by the growth of *Phragmites* on the exposed shore was the development of a *Typha* fringe. A second result is seen in the nature of the swamp on each side of the drain. This is the region of alder carr with sedges and marsh plants forming the ground flora. The *p*H of the mud here is higher than at any other part of the lake shore reaching 6·18 on the stream bank, and its inorganic content is 66 per cent. In all other parts, the carr is characterised by willow trees and is being invaded by *Sphagnum*, the mud in some parts reaching an acidity of 4·49. It would appear then that the alder and fen association owes its continuance in this region to repeated flooding by silt-bearing waters of the partially blocked drainage channel.

It is possible also, that the withholding of silt from the lake in recent years may have contributed to the increasing acidity which is evident round the shores especially on the west bank. Drainage into the lake at this side is from a high sandstone outcrop covered with a thin layer of *Calluna* peat and is no doubt highly acid. A sample taken in the *Deschampsia flexuosa* area had a *p*H of 4·15 while the acidity of the peat below the *Sphagnum* cover was 4·35. The lake water in this region has a *p*H of 6·89 compared with 7·06 off the opposite shore. The *Sphagnum-Eriophorum* bog has developed in a low-lying position at the foot of a gentle slope where it is continuously waterlogged and receives acid drainage from the surrounding land.

It would seem then that the development of vegetation round the shores of Hatchmere during the last 100 years has been a natural one following changes in the habitat. But some of the changes in the habitat have been brought about by artificial means. There seems to be no doubt that the filling up process will continue by the advance of reed swamp into the

open water followed by the development of other vegetation as the mud surface is raised above the water level. It is unlikely that this area will escape further drainage operations so the ultimate condition of the basin must remain uncertain. Further surveys, however, at intervals of about ten or fifteen years, will indicate how far the various ecological factors are still operating in the way described above.

TABLE I.

Hatchmere.

	*p*H	Percentage organic content
Phragmites	—	53·92
Phragmites (with Sphagnum) ...	5·06	62·4
Salix carr	6·07	53·3
Salix carr (with Sphagnum) ...	4·49	75·0
Alnus carr (stream bank)	6·18	43·9
Birch wood (Molinia)	3·75	82·6
Birch wood (D. flexuosa) ...	3·31	90·3
Grassland (D. flexuosa)	4·15	25·8
Bog (Molinia, Phragmites) ...	3·88	93·3
Bog (Erica tetralix, Sphagnum, papillosum, etc.)	4·18	91·7
Sphagnum bog	4·35	—
Lake water (near west shore) ...	6·89	—
Lake water (near boathouse) ...	7·06	—

*p*H estimated electrometrically.

All samples dried to constant weight at 105° C. then ignited at approximately 500° C. for 1 hour, cooled and weighed.

TABLE 2.

Hatchmere.

Frequency of species in the various zones.

	Typha reedswamp	Phragmites reedswamp	Marsh	Carr	Carr with Sphagnum	Sphagnum bog	Woodland	Ditch	Molinia bog
Phragmites communis	o	d	a	f	f	r	–	o	–
Typha angustifolia	d	f	f	–	–	f	–	–	–
Lysimachia vulgaris...	r	o	f	f	f	–	–	–	–
Epilobium palustre	r	f	o	o	–	f	–	o	–
Mentha aquatica	o	f	f	o	o	–	–	–	–
Lycopus europæus	r	o	o	–	–	–	–	–	–
Ranunculus lingua	f	r	o	–	–	–	–	–	–
Comarum palustre	f	r	f	o	o	f	–	f	–
Equisetum limosum	r	o	o	o	–	–	–	–	–
Eleocharis palustris	r	–	–	–	–	–	–	–	–
Iris pseudacorus	–	o	f	o	o	–	–	–	–
Filipendula ulmaria	–	r	f	o	o	–	–	–	–
Sparganium erectum	–	r	f	f	o	–	–	r	–
Caltha palustris	–	r	f	o	o	–	–	o	–
Heracleum spondylium	–	o	o	o	–	–	–	–	–
Angelica sylvestris	–	o	o	r	–	–	–	–	–
Valeriana officinalis	–	r	o	f	–	–	–	–	–
Lythrum salicaria	–	r	f	r	–	–	–	–	–
Galium palustre	–	f	f	f	o	–	–	–	–
Galium saxatile	–	–	–	–	–	–	f	–	–
Viola palustris	–	f	o	o	o	r	–	o	–
Scutellaria galericulata	–	o	o	–	–	–	–	–	–
Dryopteris dilatata	–	r	o	f	f	–	f	–	–
D. spinulosa	–	–	o	o	o	o	r	o	–
Athyrium filix-femina	–	–	–	–	f	–	r	–	–
Carex acutiformis	r	f	f	d	a	–	–	–	–
C. paniculata	o	o	f	o	o	–	–	–	–
C. pseudocyperus	r	r	–	–	–	–	–	–	–
C. rostrata	o	–	–	–	–	o	o	f	–
C. canescens	–	–	–	–	–	f	–	–	–
C. nigra	–	–	–	–	–	r	o	f	–
C. panicea...	–	–	–	–	–	–	–	f	–
Hydrocotyle vulgaris	–	–	o	o	o	o	–	o	–
Stellaria alsine	–	–	o	f	–	–	–	–	–
Lychnis flos-cuculi	–	–	–	–	o	–	–	r	–
Potamogeton polygonifolius ...	–	–	–	–	–	–	–	f	–

d=dominant. a=abundant. f=frequent. o=occasional. r=rare.

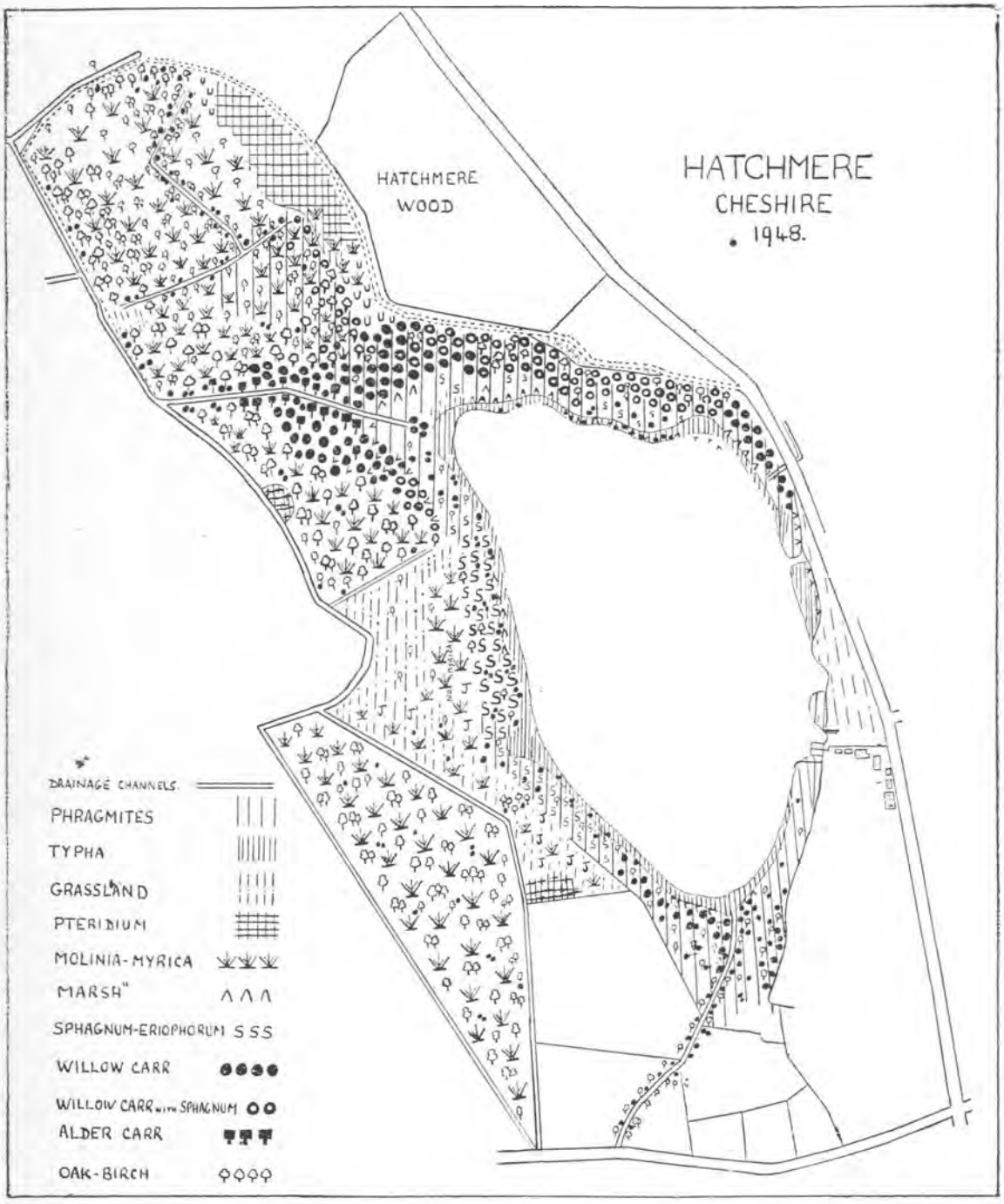
TABLE 2—*contd.*

Hatchmere.

Frequency of species in the various zones.

	Typha reedswamp	Phragmites reedswamp	Marsh	Carr	Carr with Sphagnum	Sphagnum bog	Woodland	Ditch	Molinia bog
Calamogrostis canescens ...	–	–	r	o	o	–	–	–	–
Agrostis canina	–	–	r	f	f	–	–	–	–
Deschampsia flexuosa	–	–	–	–	r	–	f	–	–
Phalaris arundinacea	–	–	–	o	–	–	–	–	–
Juncus effusus	–	–	–	–	o	r	r	f	r
Cladium mariscus	–	–	–	r	–	–	–	–	–
Cardamine flexuosa	–	–	–	f	r	–	–	–	–
Rubus fruticosus	–	–	–	r	o	–	f	–	–
Molinia caerulea	–	–	–	–	f	r	a	–	a
Myrica gale	–	–	–	–	f	–	a	–	f
Menyanthes trifoliata	–	–	–	–	–	o	–	a	o
Potentilla erecta	–	–	–	–	r	–	f	–	–
Lonicera periclymenum	–	–	–	–	r	–	f	–	–
Vaccinium myrtillus	–	–	–	–	–	–	f	–	–
Eriophorum angustifolium ...	r	–	–	–	–	a	–	f	r
E. vaginatum	–	–	–	–	–	o	–	–	–
Narthecium ossifraga	–	–	–	–	–	–	–	–	f
Erica tetralix	–	–	–	–	–	–	–	–	f
Oxycoccus quadripetala	–	–	–	–	–	–	–	–	f
Drosera rotundifolia	–	–	–	–	–	–	–	–	o
Sphagnum recurvum	r	r	r	–	f	d	o	f	f
S. cymbifolium	–	–	–	–	o	–	o	–	o
S. papillosum	–	–	–	–	r	r	–	–	f
S. squarrosum	–	r	–	–	r	–	–	–	–
S. fimbriatum	–	–	–	–	r	–	r	–	r
Polytrichum commune	–	–	r	o	o	f	o	–	o
Mnium hornum	–	–	–	o	o	–	o	o	–
M. affine	–	o	o	o	r	–	–	–	–
Hypnum giganteum	f	f	f	r	–	–	–	–	–
H. cupressiforme	–	–	–	–	–	–	f	–	o
Plagiothecium denticulatum ...	–	–	o	o	o	–	o	–	–
Brachythecium rutabulum ...	–	–	f	f	–	–	–	–	o
Aulacomnium palustre	–	–	–	–	–	–	–	–	o
Campylopus flexuosus	–	–	–	–	o	–	o	–	o
Lophocolea didentata	–	o	–	o	r	–	–	–	o
Marchantia polymorpha	–	o	–	–	–	–	–	–	–

d=dominant. a=abundant. f=frequent. o=occasional. r=rare


HATCHMERE
WOOD
HATCHMERE
CHESHIRE
1948.
DRAINAGE CHANNELS
PHRAGMITES
TYPHA
GRASSLAND
PTERIDIUM
MOLINIA-MYRICA
MARSH
SPHAGNUM-ERIOPHORUM
WILLOW CARR
WILLOW CARR with SPHAGNUM
ALDER CARR
OAK-BIRCH

Other Meres and Pools in Delamere Forest.

These meres have not yet been studied in great detail, but as the vegetation is changing rapidly it seems wise to note their condition in 1948.

Flaxmere.

Flaxmere lies near Hatchmere on the opposite side of the main road to Frodsham. Its interest lies in the fact that this obvious lake basin is now completely filled with bog vegetation and no real open water persists. There are a number of drainage channels, particularly at the north end where the surface is relatively dry and covered with *Molinia*. There is also a deep channel at the south end by which some of the water was led off by a drain discharging into Hatchmere. In spite of this, the surface at the south end is still very wet with some small pools of open water.

The wettest parts of the bog are dominated by *Sphagnum recurvum, Sph. cuspidatum, Eriophorum angustifolium*. Where there is no standing water *Erica tetralix, Eriophorum vaginatum, Oxycoccus quadripetala, Andromeda polifolia* and *Drosera rotundifolia* come in, with *Juncus effusus* and *Polytrichum commune*, while the drier hummocks are covered with *Molinia cærulea* and *Calluna vulgaris* and *Sphagnum papillosum*. There are a few birch seedlings.

Only very preliminary investigations have been made of the peat and they show it to be over a metre in depth and composed largely of *Sphagnum-Eriophorum* peat with a thin stratum of sand in some parts at about ·5 metres. It is quite possible that following drainage of the basin, the surface was dry enough to cut for turf and a layer of blown sand may have partially covered the exposed surface. The present surface has the appearance of a renewed growth of moisture-loving peat plants under more waterlogged conditions.

Flaxmere has no natural inlet or outlet. It was probably a basin very like Blackmere containing acid, peaty water and not subject to silting. The chief agent in its filling up—as at Blackmere to-day—would be species of *Sphagnum* and some *Carices* with *Eriophorum angustifolium* and *Juncus* coming in in shallower water.

Blackmere.

This pool occupies a small basin among the trees south of the railway between Delamere and Mouldsworth. It has no inlet or natural outlet and there is now no free water surface. The whole of the centre is occupied by a mass of *Sphagnum* with *Eriophorum angustifolium, Carex rostrata* and a few clumps of rushes and is much too wet to walk on except at the edge. *Sph. cuspidatum* fills the central part with *Sph. recurvum* near the bank.

Round the edge and particularly at the western end, *Erica tetralix* and *Oxycoccus quadripetala* with *Drosera rotundifolia* have established themselves with some *Molinia* spreading from the bank, and these plants are beginning to dominate the *Sphagnum*. Twenty years ago there was a good area of open water. Some not very successful drainage has been tried and this, together with the better illumination consequent upon the felling of surrounding trees during the 1914–18 war has probably hastened the natural process of filling up. If drainage continues, or if the *Sphagnum* grows so abundantly as to present a surface which is above the permanent water-level, the invasion of *Erica* and *Oxycoccus* and more terrestrial species of *Sphagnum* will continue ; and as conditions cease to be aquatic, one would expect plants like *Molinia* and *Calluna* and eventually trees to establish themselves.

The succession which can be seen in progress at Blackmere now, has probably happened in many of the low-lying hollows in Delamere Forest. The name alone suggests that this was once a district of many meres and there still exist many boggy hollows covered with small birch and a few young pines. The whole area to the west of the road from Delamere Station to Frodsham is named Blackmere on the ordnance maps, but the pool just described seems to be the only surviving piece of really aquatic habitat.

" Sinking Pools."

" Sinking Pools " are another phenomenon of the Delamere area. The best known one was at Plovers Moss just south of the junction of the main Chester-Northwich road and the road from Norley.

This area was originally a marshy tract of forest without trees. It was subsequently planted with conifers and was well covered with trees when the 1873 ordnance survey was made. In 1897 there was a pool of four to five acres and a photograph taken in 1914 shows dead trees projecting above the water surface. It has now been drained and the area is again covered with birch brushwood though old pine stumps remain. There are a few pools with rushes and the peat surface bears *Polytrichum*, some *Dryopteris dilatata* and a little *Molinia*. The depression is not very deep and hardly looks as if it could ever have come below the natural water table. The formation of the pool was probably due to impeded drainage. More recently the same thing has happened in a part of the forest just to the east of the road from Delamere Station to Hatchmere. When Professor Newstead described this pool to Chester Natural Science Society in 1937 he said that up to five years previously there was no sign of a pool and that he and his fellow naturalists had often collected moths over the area which was then only slightly boggy. The pool is now a gloomy-looking spot with its gaunt, dead trees standing up in the quite deep water.

Oakmere.

Oakmere is a much larger lake than Hatchmere with about fifty-seven acres of water surface. It lies in a depression near the road from Winsford to Chester, not far from Little Budworth. It was formerly used as a reservoir to serve Winsford, but there has been no pumping since May, 1948.

A first glance shows this mere to be different in character from those already described, in that there is now a considerable area of exposed shore partly covered with blown sand upon which vegetation is beginning to develop. There are no reeds or bulrushes, but in their place is a fringe of rushes.

It is clear that the water level has fallen considerably in the last ten years for the boat house, which formerly stood at the water edge, is now high and dry on the bank. The fall in water level has exposed a large tract of peaty shore at the north-west end which has rapidly become covered with rushes and where willows and birches are already well established. Before the

rushes became so dense, there were old tree stumps to be seen in the exposed peat, suggesting that this area had once been terrestrial, subsequently becoming submerged and now once again exposed. Pieces of peat from this north end become detached and are blown down the lake, but the bed of the mere under the water in other parts appears to consist of shingle and sand.

Oakmere has now neither inlet nor outlet though apparently it formerly had a small outlet at the north-west end, which was dammed when the lake became a reservoir. When 12,000 gallons a day were being pumped the water level quickly re-adjusted itself, presumably from springs and drainage, and now that pumping is suspended it remains at what would appear to be the level of the permanent water table in this area. If this is so the permanent water level has fallen in recent years and the present shore will remain exposed and quickly cover itself with vegetation.

Oakmere, having no inlet, is not subject to silting. The upper, drier part of the shore has a good covering of mosses, largely *Polytrichum commune*, with scattered plants of *Calluna, Molinia, Erica tetralix* and *Juncus effusus* and many young birch trees. There is a distinct drop in level as one passes from this drier zone to a wetter one with abundant mosses, more rushes, less birch and *Drosera rotundifolia* on the bare peat. Between this and the water edge at the peaty end, is a very wet zone with abundant rushes, *Hydrocotyle, Sphagnum* and aquatic mosses. The *Hydrocotyle* spreads right into the water where it is joined by *Juncus bulbosus*. Scattered over all zones are seedlings of birch, pine, willow and rowan.

In 1935, when the water level was very low, a keeled dug-out canoe was found half-buried in the shore. Mr. Rock, the keeper, noticed the prow of the canoe exposed about the level of the mere. It was carefully excavated and found to be resting on a bed of gravel and silt and covered with sand interstratified with peat. (Newstead.)

In 1940 two bombs fell in the wood near Mr. Rock's house. This made a considerable disturbance in the underlying sand layers and water escaped from the mere causing a further slight drop in the level.

The water at Oakmere is much more acid than that of Hatchmere, sometimes reaching *p*H 4·5 and it has a peculiar phytoplankton of which the oil-forming alga, *Botryococcus*, is the most common component.

The evidence so far suggests that Oakmere also fills a basin in the glacial sands which drops below the permanent water table. It is spring fed and has long been subject to fluctuations in water level. During a previous period of low water, vegetation formed peat in the shallow bays. This peat was later submerged and is now exposed and being recolonised.

[This work was carried out from the Department of Botany, Manchester University, to whose members the author expresses her thanks for help in the field.]

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