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THE

ORIGIN OF THE BRITISH FLORA.

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BY

CLEMENT REID,

F.R.S., F.L.S., F.G.S.,

OF THE GEOLOGICAL SURVEY OF ENGLAND AND WALES.

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PREFACE.

While embodying in this book the results which I have accumulated during the past twenty years, I should like to take the opportunity of thanking the many friends who have assisted me. The first to do so were Mr. Carruthers and Professor A. G. Nathorst, whose work, in fact, led me to undertake these studies. In the troublesome work of determining the plants I have been greatly aided by the constant courtesy and assistance of the officers of the Botanical Department of the British Museum, especially of my friends Mr. E. G. Baker and Mr. A. B. Rendle. At Kew also I have received every facility for the work, and to Mr. J. G. Baker, the late keeper of the Herbarium, I owe much. Messrs. G. and H. Groves have also assisted me at various times with specimens of recent plants which I was unable to obtain for myself, and others have been received from friends whose names are too numerous to mention.

With regard to the geological material that I have obtained from others, specimens have been received from so many sources that I must leave the reference at the head of each locality to speak for itself, only acknowledging the special aid that has been given by Mr. James Bennie, in collecting the plants of the ancient silted-up lakes of the Scottish Lowlands. For the constant encouragement of Sir Archibald Geikie, Director-General of the Geological Survey, I am also very grateful.

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CHAPTER I.

Introduction.

In the year 1876, happening to be engaged on the Geological Survey of East Norfolk, I was led to commence observation on the plants of the Preglacial 'Cromer Forest-bed.' At first I confined my efforts to collecting the animals and plants, some of the latter being afterwards determined by Mr. Carruthers. But it soon became obvious that, in order to obtain any satisfactory knowledge of the subject, it was necessary to collect and study the ripe seeds and fruits of our British plants, and to devote much of my leisure to the work of comparison; fossil seeds had seldom been collected in this country, and recent plants with perfectly ripe seeds were seldom to be found in our herbaria.

From a study of the plants of the Cromer Forest-bed, the work gradually expanded into an examination of any Newer Tertiary plants that could be found in Britain, and as during the past twenty years my employment on the Geological Survey of England has necessitated a close scrutiny of our Newer Tertiary deposits, especially in the south and east of England, I have been brought continually face to face with the problems of the origin of our fauna and flora, and the relations these bear to the climatic changes through which this country has passed.

Moreover, this life spent principally in field, and moor, and forest has forced me to observe how each changing season is marked by corresponding adaptations in the animals and plants, such as enable the species to preserve themselves, to multiply, and to spread ; or, if adaptation fails at any point, through some climatic irregularity, how sweeping and rapid may be the extermination of all except some few accidentally favoured individuals. While collecting seeds and fruits for comparison with the fossils I was compelled particularly to observe their many adaptations for dispersal, and also their times of ripening, and the abundance or scarcity of ripe seeds.

It was impossible under such circumstances to avoid seeing the close connexion which must exist between the present geographical distribution of plants and animals and bygone changes in climate and in physical geography. Edward Forbes' * essay was read and read again ; but it soon became apparent that his brilliant generalisations, though far in advance of the date when they were written, were only partially true. Much of his reasoning was fallacious.

To explain the presence of Arctic and of Iberian plants in Britain, he showed that outliers of the Arctic flora stranded on our mountain peaks could be accounted for by an appeal to the climatic conditions of former days, when a similar flora covered the whole of our Islands, and was not confined to isolated mountains. He did not see, apparently, that the use of this reasoning precluded the use of the

* 'On the Connexion between the Distribution of the existing Fauna and Flora of the British Isles, and the Geological Changes which have affected their area, especially during the epoch of the Northern Drift.'—*Mem. Geol. Survey*, Vol. I., pp. 336–432 (1846).

converse hypothesis of a warm climate continuous from Preglacial times to account for the Iberian plants in the west of Ireland and in Cornwall. Either might be true, but scarcely both ; for the Irish and Cornish plants are not such as could survive a colder climate like that postulated by Forbes to explain the migration of the Arctic species. We have obtained direct evidence, since Forbes wrote, that all Ireland was at one time strongly glaciated, and also that Arctic plants once occupied the lowlands of Devonshire.

This problem of the origin of our flora is one which can be solved, I think, by the historical method, and that seems to be the proper mode of attacking it. No doubt the imperfection of the geological record is so great as to make the task an exceedingly difficult one ; for nowhere have we yet discovered a continuous sequence of deposits, all fossiliferous, such as would give a connected history of our recent animals and plants from their first appearance in Britain to the present day. The exact order of succession of the deposits, of the physical changes, of the climatic alternations, and of the waves of migration, is still uncertain ; though a definite historical record is gradually being built up by the comparison and correlation of numerous overlapping chronicles, each recording at most some three or four of the subordinate stages or periods. This work of correlation, as already mentioned, has been greatly facilitated by a detailed examination of extensive areas, and a close study of the geology of the more recent deposits. In this way I have been enabled to trace the connexion between the strata, and often to speak with confidence as to the date of groups of fossils which otherwise would have had to remain as isolated finds. My own researches have been largely aided and supplemented by the examination of material obtained from friends working in districts which I have had but slight opportunity of studying. This has especially been the case with regard to the lacustrine deposits of the Scottish Lowlands, so minutely examined by Mr. James Bennie. The results of these investigations will be found summarised in Chapters IV. and V. of this work.

In the examination of our recent flora I have looked at the plants mainly from the point of view of the field-naturalist. Their climatic and geographical distribution; the periods of ripening, and the means of dispersal of their seeds; their competition with other plants; and their dependence on, or destruction by animals, were the circumstances especially noted—more so than critical distinctions of varieties and sub-species. Not that these distinctions are considered unimportant, but mainly because of the difficulty of studying them without a complete herbarium, too heavy to transport during constant changes of station. Moreover, botanists have almost ignored the essential distinction between a varietal form due to local conditions, and a true sub-species or race; for many of our named sub-species have evidently no more claim to such rank than have luxuriant garden specimens. Forms, for instance, of the water-crowfoot (*Ranunculus aquatilis*) or of the lesser spearwort (*R. Flammula*) growing in a well-manured horse-pond or ditch have no claim to rank as sub-species, unless they can be found also under more natural conditions, and come true from seed. Again, the prostrate maritime form of broom found in Cornwall (*Cytisus scoparius*, var. *prostratus*) has similarly no claim to varietal rank, for Mr. Mitten tells me that seeds gathered by him grew in his garden into the common erect form of broom. A botanical visit to the Dingle Promontory, in Kerry, in company with Mr. Edmund Baker, produced several instances of this sort. We examined *Saxifraga umbrosa* and its allied forms, of which we found several, each occupying well-defined small areas, and apparently possessing definite characters. But, as more and more of the patches were examined, these distinctions were found to melt away; for each fresh patch yielded a slightly different form, so that finally we were able to obtain a nearly complete series of intermediates seeming to connect the extreme *S. umbrosa* with the extreme *S. Geum*, all of them living within a small area under similar conditions. *Pinguicula vulgaris* and *P. grandiflora*, on the other hand, we found growing together in abundance, and quite distinct except at one spot where, below a rock on which both grew, we found a number of hybrids. In this case the allied forms, sometimes only ranked as sub-species, are both good species, and have different geographical distributions, though they overlap at more than one point. Botanical books are full of similar anomalies, often due to a natural desire to announce the discovery of a form new to Britain; but for the student of geographical distribution varietal names founded on such material are worse than useless. For they tend to confound sub-species, which, if found in isolated areas show, in all probability, a transportation of the seeds from one to another, with varieties or forms, which will reappear wherever the parent species is subject to particular conditions.

A flora like that of the British Islands may be studied in so many different ways, that it will be well to define at once the standpoints from which it is viewed in the following pages. I do not propose, nor do I feel competent, to touch on the questions of the evolution of the species, or of their relationship to each other; what will be attempted in Chapter II. is, to give a sketch of the existing flora as a whole, to note its composition, and the distribution of the species. Chapter III. will deal with the means of dispersal of the various species which constitute our flora, with special reference to the present and past distribution of the plants. Finally, I propose to give an historical account of each species as far back as geological evidence will yet allow it to be traced.

It may be considered presumptuous to attempt such a task ; but, though the following Chapters are most imperfect, yet they may do good by directing attention to lines and methods of research which are as yet little appreciated. The section on the geological history of our flora, being a record of the actual distribution in space and time of our plants from direct observation, will perhaps be the one to which botanists will most readily turn. It may be suggested, however, that the section on means of dispersal is equally important, and that the connexion between the different Chapters is so close that it is impossible properly to appreciate the relationship of the living plants to their fossil representatives without a study of the subject from various points.

Though the present volume is professedly occupied with a discussion of the origin of the British flora, it should not be forgotten that in questions of geographical distribution it is impossible to separate animals from plants, for many plants are directly dependent on certain animals for means of dispersal. Moreover, certain animals are dispersed by the same means as flowering plants, have the same difficulties to contend with, are no less dependent on climatic conditions, and are almost equally tied to a single spot during the lifetime of the individual. The land mollusca in particular are in these respects so like the more sedentary species of flowering plants that I have not hesitated to speak of them where they help to illustrate the subject under consideration. Beetles, I believe, would also be of use ; but of this order I have unfortunately no knowledge, and at present few of the numerous fossil species occurring in our Pleistocene deposits have been determined. Freshwater mollusca, freshwater fish, and amphibia seem to obey the same laws of geographical distribution as aquatic plants: the species are usually of wide range, provided the barriers are not excessively broad or high, and the climatic conditions are suitable.

The geological sketch has been greatly condensed; for it is obviously impossible to deal with so complicated a subject in a limited space, and all that can be done is to give some indication of the climatic conditions, local peculiarities, and character of the flora at each spot where plant-bearing deposits are found. The thorny subject of bygone alternations of climate is perforce discussed, for it lies at the root of our inquiry. I have also been obliged to deal with another equally vexed question, the submergence or elevation of the land in Pleistocene times; for this obviously has a most important bearing on the possible survival of plants within our Islands. In discussing the past climatic changes, while giving the preference to the evidence derived from remains of plants belonging to existing species, I have not hesitated to supplement this by an appeal to other groups of organisms, or to inorganic geology; for an assemblage of Arctic mammals, a group of Arctic or desert mollusca, a morainic deposit, or erratics brought by floating ice in an Arctic sea, are as good evidence of climate as a group of plants, and are often discoverable in strata in which no plants are preserved.

Perhaps it will be asked why, if the British flora is to be treated from standpoints which involve a consideration of climatic and geographic changes such as cannot be merely local, a still wider view is not taken, and this flora dealt with as a mere outlier of the Palæarctic one? To this I may reply, firstly, that the fossil plants of the periods dealt with are at present almost unknown outside Britain, Sweden, and North Germany, and speculation would have to take the place of an appeal to direct evidence. Secondly, that Britain is not by any means simply an outlier of the continent of Europe. Its flora is an insular one of peculiar character, unlike that of any part of Europe, and unlike that of an oceanic Island. Few, if any, of the species are confined to Britain ; but the Islands contain a selection of the continental species best adapted for dispersal, and best able to hold their own in a changing climate. Britain, within the lifetime of existing species, has been subjected to many fluctuations of climate, which have left their mark on the flora. On these fluctuations was superimposed a series of orographic changes, such as must have tended greatly to modify local conditions, and must sometimes have aided, sometimes have hindered, the dispersal of the seeds.

The following pages deal, therefore, with an insular flora of exceptional type ; in the building up of which selection and sweeping extermination have played so vigorous a part, that the flora now consists largely of an assemblage of the more readily dispersed of the Palæarctic species. Time has not permitted any large amount of variation or formation of sub-species in these Islands ; and in this our flora is totally different from the more ancient floras of oceanic islands, which were beyond the reach of such violent climatic fluctuations as have affected Britain.

There is one point which needs explanation before we proceed further. I have been obliged in the following pages to go back to the popular and original use of the term 'seed.' Of the two senses the popular one seems to be by far the most useful scientifically, for it refers to the thing that is sown, not to an embryo with or without certain appendages and coverings, which in function may be quite indistinguishable from others belonging to the fruit. A seed, therefore, for our present purposes is the one-seeded unit of dispersal. All our British fruits, with the single exception of that of the Cornel, divide into such one-seeded portions, which tend to be dispersed separately, so that the young plants do not interfere with each other. These units may be seeds in the strict botanical sense, or they may be complete one-seeded fruits ; sometimes they are stones or carpels, one-seeded, or at any rate with only one of the seeds properly developed ; in other cases they include the dried calyx, or other parts of the flower or receptacle. Constant explanation would be needed if an attempt were made to define botanically what part of the fruit is referred to in each case—it is more convenient to accept the perfectly understood popular usage.

CHAPTER II.

The Present Flora of Britain.

WHEN the British Flora is carefully studied, it is found to be composed of numerous elements, and can be divided into several well-marked groups. The grouping of the species, however, varies according to the point from which they are viewed. Disregarding purely botanical affinities, which are not under consideration in this volume, the assemblages necessarily differ according as the flora is looked at from the standpoint of relationship of the plants to climatic conditions; or from the standpoint of habitat, including variations in soil, and shelter; or again, from that of local distribution. No one of these methods will enable the plants to be grouped into 'provinces' satisfactory for all purposes. Each set of conditions overlies and modifies the distribution which either of the others alone would tend to bring about.

If we begin with the broadest classification, that based on climatic conditions, we find at once that this is not merely a question of average, or of extreme temperature. It is temperature plus amount of moisture, modified in various ways by the season at which the rain falls, the amount of sunshine, and the season at which the sun is felt. A flowering plant has varying needs at different seasons; and the satisfying of these is so essential to the existence of the species—not necessarily, I would remark, the same thing as essential to the existence of the individual—that, if the conditions are unfavourable for any one of them, the plant cannot maintain itself. The seed must have the right temperature, soil, and amount of moisture to enable it to germinate and grow. The young plant must have sufficient vigour to defend itself against parasites or aggressors—not like the wheat which cannot grow among our ordinary weeds, and depends on human protection. The climatic conditions at the time of flowering must be favourable, or the ovule may not be fertilised. For the ripening of the seed a certain critical temperature must be reached, and maintained for a sufficient time. The cold or wet in the winter must not be such as to destroy the seed before it has germinated. All these conditions must be favourable or the plant cannot establish itself. An annual plant must seed every year, and go through the whole round safely, or it will be destroyed. A perennial plant need seed and grow from seedlings only once in a generation.

As instances of what is meant by these remarks I will take a few common plants. The horse-chestnut grows well even as far north as Bergen in Norway, and in Britain it produces abundance of ripe seeds every year; but even in the south of England, as far as I am aware, it never succeeds in establishing itself from self-sown seeds. The common elm (*Ulmus campestris*), on the other hand, in England only produces perfect seed about once in forty years. Forty years is far less than the lifetime of an elm, and if the tree seeds once in a lifetime, and the seed germinates, the species may establish itself. Perfect seeds have not come under my observation, and I cannot therefore say whether this elm does grow from seedlings. It is generally said only to occur where planted. The butcher's broom (*Ruscus aculeatus*) is an instance of a plant which just manages to hold its own. After watching its fruiting for twelve years in succession, I find that as a rule only about one plant in fifty produces any fruit, and these are not only few in number, but, as they ripen in November, an early winter may prevent them ripening at all. The plant being perennial and hardy can survive, but it has evidently reached its northern limit in Britain.* The sycamore, maritime pine, and common rhododendron (*R. ponticum*) are instances of plants undoubtedly introduced, which seed and grow freely from seedings in the South of England. That they were not till lately members of our flora is evidently due to geographic, not to climatic conditions.

We cannot point to any British annuals which do not seed freely in some part of the Islands, for the sufficient reason that an annual which cannot seed well may be entirely exterminated by a single exceptional season. This points to a probable explanation of the curious tendency noticed in the floras of small oceanic islands, for genera ordinarily annual and herbaceous to be represented by perennial species. This may be explained in the following way. In many annual plants a few individuals become biennial; these in an island devastated by an exceptional gale at flowering time, by a swarm of locusts, or other adverse conditions, would be the only ones to survive, and natural selection would thus tend to perpetuate the biennial or perennial forms which so characterise these islands. This change of annual into perennial forms, however, in all probability has had little effect on the British plants; for the Islands, besides being too large, are sufficiently close to the Continent to receive occasional seeds or pollen of the same species, which by intercrossing would tend to keep the species true.

* The exceptionally warm and dry summer and autumn of 1898, however, caused *Ruscus* to fruit so freely in Hampshire that I counted upwards of forty ripe berries on each of several plants.

Climatic conditions cause two very distinct floras to be represented in Britain. The lowland flora is in the main the temperate flora of the neighbouring lowlands of Belgium and France. The upland flora, on the other hand, consists of numerous more or less isolated outliers of the flora which overspreads the lowlands of the Arctic Regions and occupies the mountains of Scandinavia. This latter assemblage is found at higher and higher elevations as it is traced southward, and is confined to hills sufficiently high to have an average temperature approaching that met with at the sea-level within the Arctic Circle. As the fall of temperature is about 1° Fahr. for every 300 feet of elevation, a sub-arctic climate is found over a considerable area in Scotland, and on a certain number of isolated hills in England, Wales, and Ireland. The seeds of the British Alpine plants are invariably small and usually very minute, a peculiarity that will be again alluded to.

Local conditions govern the distribution of large groups of species. First, there are the sea-coast plants, which are all confined to a narrow belt near the sea. This flora is very uniform throughout Britain, though some of the species are found only on the south coast and a few only on the east.

The seeds of maritime plants are of various descriptions, and often of large size. Many of them are scattered far and wide by the sea, though the plants only establish themselves where a suitable habitat occurs. Thus the sea-coast flora includes a good many plants like the sea-kale (*Crambe maritima*), which tend to appear sporadically wherever the habitat is suitable and to disappear again after a few years—as though dispersal were easy, and the range of the species was limited by climatic rather than by other considerations. Many of the sand-dune or shingle-beach species are more properly desert plants, and are only confined to the coast because in Britain we have no other suitable regions.

The aquatic flora consists largely of species of wide range, which have a remarkable power of reaching isolated rivers, lakes, or ponds. Though some of these species are confined to limited areas, most of them tend to re-appear wherever the local conditions are favourable. They are apparently more limited in their northerly range by unfavourable climate than by difficulty of crossing barriers. Several of the aquatic plants of limited range are almost confined to the East Anglian broads and rivers; but this limitation is evidently due to the more extensive and connected waterways of that district, rather than to other conditions. Not one of our aquatic plants is a member of the Alpine flora, or belongs to the Lusitanian group found in Cornwall and in the West of Ireland.

Among the marsh and peat-moss plants are many of which the local distribution is evidently governed by climate and geographical position, and is not dependent on soil or amount of rainfall. A large group of these plants consists of upland forms, such as the Arctic willows and sedges. Another set is confined to the Eastern Counties; though these are few in number, notwithstanding the large area of swampy ground there found. A third group is confined to the South-west of England, or to the West of Ireland.

The anomalies in the distribution of our peat-moss and marsh plants are very striking, especially as this flora probably has been less affected by human agency than any other, except the Alpine. Man may have drained a certain number of swamps, and thus exterminated some species, principally in the Fenland; but it is not probable that he has had much to do with the introduction of new species, or the transfer to other widely separated localities of species already in Britain. Marsh plants, of all the groups, are the least likely to be introduced accidentally or on purpose by man.

Many of the heath or barren-land plants might be classed equally well as marsh species, for gravelly or sandy areas tend to become peaty and waterlogged in our climate. The most marked characteristic of this flora is the occurrence in it of certain gregarious plants, which occupy definite areas in enormous profusion, though entirely absent from others equally suitable. Several of our heaths, for instance, are very local, though all of them occur abundantly where found at all. The British plants which have a marked western geographical distribution within the Islands nearly all belong to the marsh and heath groups.

Of the other open-land groups, that belonging to good soil and clayey meadows is surprisingly restricted, and many of the species are probably late introductions. It is not difficult to see the reason why we have so few species characteristic of our wide areas of clayey pasture. These, till recent times, were woodland, not open prairie, and since the destruction of the woods they have been under cultivation or closely grazed. We have therefore nothing equivalent to the prairie vegetation of North America or other drier climates. Several plants confined to the eastern counties belong, however, to this group; for there the dry cutting winds of winter probably always prevented the forest growth from extending to the sea, even where the soil was richest. The other meadow species have generally a wide range throughout Britain, wherever the climate is suitable.

Our woodland plants are extremely difficult to deal with, partly on account of the wholesale destruction of the ancient forests, partly because of the extensive planting, which has introduced trees belonging to other districts and has profoundly modified our woodland flora. To take one or two instances, the Hornbeam is one of the principal ancient trees of Essex and other south-eastern counties; but in the New Forest it only occurs sporadically, near houses and villages, and such would seem to be its ordinary mode of occurrence in most parts of Britain. We cannot, however, say positively that it can only be reckoned as indigenous over a certain limited area, though the evidence points in that direction. The Scotch Pine is equally doubtful, for it was abundant throughout Britain when our existing peat-mosses began to form; it afterwards disappeared throughout the south of England; but now that it has been re-introduced it seeds freely and is fast spreading, especially in Hampshire and Dorset. It is probable that as far back as Roman times trees were planted round the villas for shade and beauty, and Roman officers would probably have given preference to southern forms which reminded them of their native lands. Thus such trees as the Horse Chestnut, Spanish Chestnut, Sycamore, Lime, and probably the Vine and Fig-tree, would be introduced. Some of the trees died out, others established themselves from seedlings and still remain; but except through the negative evidence of the geological record there seems to be no satisfactory way of telling which of our rarer trees were thus introduced.

Besides the forest-trees, we have a large number of plants which are confined to woods; we have also several species of land-snails, which are similarly restricted to ancient forest and are not found in modern plantations. The moisture and shelter of our woods make the general character of the undergrowth fairly uniform throughout Britain; though we possess a large number of woodland plants which are confined to a few widely separated localities. Some of the *Liliaceæ* and *Boragineæ*, for instance, though abundant where they occur, are curiously local, most of them being absent from extensive areas apparently as well suited for their growth as those in which they are found. In the altered state of our woods these anomalies are particularly difficult to understand, for the plants usually do not appear to group themselves into assemblages confined to special districts, and the distribution of each species has to be studied separately. Not one of our woodland mollusca or plants, unless the *Arbutus* be reckoned as a forest species, falls into the special groups confined to the eastern counties, to Cornwall, or to the West of Ireland. It is a question whether the absence of Lusitanian woodland species may not be due merely to the destruction of forests in Cornwall and in the West of Ireland; but this cannot be determined till the sub-fossil plants of the forests buried under the recent peat in these districts have been collected and examined. It is possible that some of the difficulties may be cleared up when we have studied each patch of ancient woodland, however small; for by searching small isolated patches of old forest we can often find outliers of the sedentary woodland mollusca and plants, such as probably once extended over wide areas now bare or under cultivation.

A certain number of our plants are confined to limestone rocks or to calcareous soils; but it will be sufficient here to remark that none of them is characteristically eastern or western, and that scarcely anything is yet known of any of them in the fossil state.

In addition to these classifications according to climate or habitat, there is yet another, certain species being eastern and others western. Though we have a considerable number of plants which are confined to the Eastern Counties, they, or at any rate the majority of them, have not a correspondingly eastern distribution on the Continent, and so many of them occur throughout the greater part of Europe, that the present local distribution in Britain may be, after all, climatic rather than geographical. The Eastern Counties are considerably drier and more sunny than the others, in this agreeing more nearly with the mainland of the Continent.

Our western plants, on the other hand, are very peculiar, for we find in Cornwall and Devon, and also in the West of Ireland, groups of plants characteristic of the Pyrenean region. These plants occur usually not as rarities but in profusion, so that in parts of the West of Ireland the common species which carpet the hill-sides are Iberian forms unknown elsewhere in Britain. There is also another peculiarity which must be taken into account when we discuss the origin of these outliers—though Pyrenean plants occur both in the south-west of England and in the West of Ireland, the species found in the two districts are not the same. Thus Cornwall possesses two of the Pyrenean heath-plants, *Erica ciliaris* (another outlier of which occurs in Dorset) and *Erica vagans;* while the four found in the West of Ireland, *Erica Mackayi*, *Erica mediterranea*, *Dabeocia polifolia*, and *Arbutus Unedo*, are all different from the Cornish ones. The only western plants common to the two regions are three spurges, two of which are sea-coast species. Nearly all the Pyrenean plants found in the British Islands, including the only tree belonging to this group, have minute seeds, the numerous large-seeded trees and plants which are associated with them in Spain not extending into Britain.

Three American plants also occur in Ireland, but the distribution of these is too peculiar to permit of any attempt at explanation in the present state of our knowledge as to the former range of these species. *Spiranthes Romanzoviana* occurs in Cork, and in North America and Kamtschatka; *Sisyrinchium angustifolium* is found in bogs in Galway and Kerry, and also in Arctic and Temperate North America; *Eriocaulon septangulare* is an aquatic plant occurring in Skye and the West of Ireland, and also in North America.

From the above notes it will be seen that Britain shows signs of a geographical distribution of plants largely independent of that due to climate; or, perhaps we should say, not governed by existing climatic conditions. The cause of these peculiarities will be best discussed when we have examined into the means of dispersal possessed by different plants; but it will be as well at once to say that the subject is beset with difficulties, and at every turn we meet with instances of anomalous distribution, such as make a botanist inclined to suggest 'accidental introduction by man' were it not that many of the species are marsh or woodland forms, long established and most unlikely to be brought by human agency in any form. Perhaps future research may show that many of the outliers were once less isolated, and that the present distribution is not so unaccountable as it seems. Such has already been shown to be the case with many mammals and mollusca, which geology proves had once a much wider distribution; but the flora of our Later Tertiary deposits has not yet been collected and studied so thoroughly as has the fauna.

CHAPTER III.

Means of Dispersal.

WHEN the adaptation of plants for dispersal is spoken of, one thinks of winged seeds, or of clinging burrs, of floating nuts, of succulent fruits which tempt birds, or of other obvious adaptations. These, however, form only a few of the contrivances made use of by nature to aid plants to hold their own and to extend their range. On considering what is necessary to the existence of a species, it soon becomes evident that modes of dispersal that seem to be merely accidental really depend on some modification of the seed or plant. They are often alternative methods without which the very life of the species would be in danger.

No plant of the Temperate Regions—I do not speak of Tropical species—would be likely to hold its own for long periods if it were confined to a single station. The sweeping climatic waves which time and again have passed over our latitudes within the life-time of the existing species must have compelled every one now found in Britain to move. When deep snow and ice smothered our uplands, the Alpine flora had to descend to the lowlands; when a warmer climate returned, the Arctic plants had to leave the low ground and again climb the heights. The lowland plants, on the other hand, with few exceptions, had to leave the country when the Reindeer, Arctic Fox, and Lemming inhabited Salisbury Plain, and the Arctic Birch and Bearberry grew in the lowlands of South Devon. The Temperate flora has returned again; but the fact that the whole, or nearly the whole, of our plants have been compelled at least twice, probably many more times, to migrate long distances, shows that the British flora as it now exists must be a flora highly specialised for dispersal. In this respect it is probably more specialised than any tropical flora, which has been developed in an unvarying climate, but under a struggle for existence more violent to the individual.

We should expect to find, therefore, that the British flora consists of a selection of the more mobile plants of Europe, without the accompanying sedentary forms. As the best illustration of what is meant, we may take the proportions of plants with minute seeds and of plants with large seeds to the total number, in orders represented both in the flora of Britain and in that of Europe; the numbers not including plants that have seeds, either large or small, modified in special ways for dispersal over long distances. The approximate percentages are as follows:—

	Percentage in Britain.	Percentage in Europe.
Large seeds	24·5	31·3
Small seeds	17·6	12·4

The composites, which at first sight appear to form an order particularly adapted for dispersal, constitute, however, a much smaller proportion of the British than of the continental plants. This, I believe, is due to the general deficiency in our flora of prairie vegetation—the majority of the composites are prairie species, and until the last thousand years Britain, while possessing a temperate climate, was mainly woodland, so that there was only comparatively small area suited to their needs.

Before studying more minutely the means of dispersal available, it may be well to ask, in this connexion, what are the requirements that are usually essential to the life of the species. In the first place, it is necessary that the seed should be sown beyond the limit of the patch of soil exhausted by the parent plant. For this a very slight mobility is requisite. Secondly, in the case of British plants, some method is ordinarily needed by which they are enabled to cross barriers, such as rivers or straits, or tracts of desert in which the plant cannot flourish.

I use the term 'desert' as implying areas unfavourable to any particular species. A desert from the human standpoint is a sandy waste without water, which is unsuitable for the plants and animals useful to man. Such an area may be gay with flowers, and is no desert to the Gorse or Horned Poppy—the desert to them is the luxuriant meadow or forest, which they cannot overpass unless their seeds are carried by some rapid messenger. To a water-plant the dry land is a desert ; to a mountain plant the lowlands are desert ; to the lowland plants the mountain is a desert ; and to go further, to certain plants everything but limestone rock is a desert. Consequently the British Isles consist not only of an Archipelago with numerous islands, but from the points of view of different plants the area forms quite different Archipelagos, of low-lands with scattered mountain tops, of non-calcareous country with isolated limestone, or of dry land with scattered lakes.

In gregarious plants, such as heaths and rushes, the necessity for scattering the seeds beyond the shadow of, and beyond the soil exhausted by the parent species, may mean that only the outer individuals of each cluster, presumably on the average those that have already been selected by the dispersing agency, have much chance of propagating themselves. In the case of small-seeded gregarious plants like the heaths, without highly specialised means of dispersal, this difficulty probably tends to keep the seeds small and chaffy, so as easily to be scattered by the wind. The berry-bearing heath-plants on the other hand, though equally gregarious, have seeds fewer, larger, heavier, and with thicker walls. These latter have been modified for dispersal by birds. The small-seeded heaths without special adaptation for dispersal are often singularly local; though occurring in profusion, they tend to occupy widely separated areas, and are absent from other districts equally favourable. The berry-bearing species are of more general occurrence in suitable localities, though individually they may not be so abundant.

Other species have special methods of throwing the seeds beyond the shadow of the parent plant. The Gorse, Wood-sorrel, Geranium, and Spurge forcibly eject their seeds from the ripe pod or capsule. The acorn is attached lightly for some time after it is ripe, and grows at the end of a thin branch which, lashed by the October gales, flings the acorn as boys throw clay-pellets from the end of a switch. Many umbelliferous plants have a similar mode of scattering their seed; for when ripe the carpophore splits and the seeds hang loosely by their upper ends to the two whip-like filaments. At the same period the withered plant hardens and becomes very elastic, so that any passing animal causes it to spring back and throw off the seeds, which unless thus scattered, tend to hang on till they decay. This process one can study in a patch of these withered umbellifers, part of which is accessible to animals, and part of which is cut off by a fence so that it has remained undisturbed. Umbelliferous plants which possess burrs, however, behave quite differently. They are less tall and springy, and, like other plants with burrs, are so arranged as to scrape the burrs against any passing animal, but usually not to fling them.

Many plants have capsules so arranged as to scatter the seeds when forcibly disturbed, but not otherwise to drop them. The Poppies, Wild Hyacinth, Henbane, and various caryophyllaceous plants, have capsules erect in fruit and opening above, and the stems become stiff and elastic when the seeds are ripe. In some plants such as *Erodium*, the seed can actually crawl away from the parent. Certain trees, such as the Ash, Maple, Hornbeam, and Pine possess winged fruits which when detached by a breeze tend to be carried short distances, clear of the shadow of the parent, though the seed itself is of considerable weight. They combine in this way the advantages of a large embryo, which gives the young plant a copious store of nutriment to draw from while it is competing with the short herbage, with a seed sufficiently mobile to reach places where it can obtain sunshine and new soil.

The majority of our plants, as already remarked, have other means of dispersal, which will enable the species occasionally to overleap barriers—a faculty very different and probably far more important than the slow spreading over short stages that has just been spoken of. Here it may be pointed out that this conquest of the land foot by foot or yard by yard is insufficient to account for the present distribution of our flora. It cannot surmount barriers, and will not account for the mode of occurrence of such a plant as *Erica ciliaris*, which occupies in profusion two compact areas, one in Cornwall and one in Dorset, and has every appearance of spreading in each case from a single seed accidentally transported from some distant region. The British flora is full of anomalies of this sort. I may also point out as a geologist that sufficient time cannot be allowed for this method of spreading, even on the unwarrantable supposition that our plants could find a continuous belt of suitable country all the way from Central Europe, or whatever country they were obliged to take refuge in during the Glacial Epoch, to the furthest point they have now reached. Though the Postglacial period counts its thousands of years, it was not indefinitely long, and few plants that merely scatter their seed could advance more than a yard in a year; for, though the seed might be thrown further, it would be several seasons before an oak, for instance, would be sufficiently grown to form a fresh starting point. The oak, to gain its present most northerly position in North Britain after being driven out by the cold, probably had to travel fully six hundred miles, and this without external aid would take something like a million years. I doubt whether anything like this time has elapsed since the Arctic flora occupied the lowlands of the south of England and the reindeer inhabited Central France.

Most of our plants have special adaptations for dispersal over long distances, and, as the different modes of transportation must necessarily lead to different geographical distributions in different orders, a classification of plants and animals founded solely on method of migration ought to throw much light on some obscure problem in geographical distribution. I am afraid, however, that at present we have not sufficient direct evidence and can only speak in a general way of these facilities; though new observations are made from day to day, and Darwin collected a large body of evidence on this subject.* The

* *Origin of Species*, 6th edition, pp. 323–330.

main directions in which British plants are specially adapted for dispersal are the following :—

Modification.	*Mode of Dispersal.*
Abundance of minute seeds (Heaths, Rushes, Saxifrages, Caryophyllaceæ, &c.).	Readily moved by accidents of all sorts.
Abundance of large edible seeds (Oak, Pine, Hornbeam, Ivy, &c.).	Eaten or dropped by birds ; most are destroyed, but some are transported uninjured.
Edible fruits with hard stones (Blackberry, Hawthorn, Holly, Arbutus, &c.).	Eaten by birds and mammals ; seeds passed uninjured.
Winged seeds (many Composites, Willows, &c.).	Transported by wind.
Winged seeds with lax hairs (Willow-herbs, Willows, Bulrush, &c.).	Cling to feathers or fur.
Burrs and hooked seeds.	Cling to feathers or fur.
Floating seeds.	Transported by water.
Cut-leaved submerged water-plants (Water-crowfoot, Water-milfoil, &c.).	Collapse and cling when removed from the water ; stems fragile, and broken pieces grow. Carried on legs of mammals or of wading birds.

The first group, the minute-seeded plants, is a very large one, and it will readily be understood that the plants belonging to it include nearly all the British species which show strikingly anomalous distribution. Nearly all of our Alpine plants, of the Lusitanian species found in Ireland

and Cornwall, and of the peculiar eastern-county plants belong to this group, the larger seeded species found associated with them on the Continent being absent. These plants seem therefore to possess in a pre-eminent degree the power of crossing seas like that which separates Ireland from the Pyrenees. They are probably transported freely by migrating birds, either on their feet or in their feathers ; but the moist-soil species must also have been carried in profusion in the cakes of mud which adhere to the flanks of oxen that have rested in a moist meadow till the earth has dried on them. Before fences were made, the migrating horses, oxen, and bisons, in this way must have carried such seeds for long distances, and any adhering to the head of an animal would be carried across an arm of the sea uninjured. It must be remembered, however, that the autumn migration of mammals, which is the migration when nearly all the seeds are ripe, would have been southward in Britain,and consequently could only carry plants in that direction. The northward migration taking place in spring, few seeds would be carried, except such as had become entangled in the fur and were shed with it next summer. Wading and swimming birds, on the other hand, commonly come to Britain from the north and east in autumn, leaving the colder districts at a time when the seeds are ripe, thus bringing the smaller ones to this country. This is probably the reason why so large a proportion of the minute-seeded Arctic plants are found in Britain, though many of the species only occur in small numbers and at various scattered localities.

The next group, that containing the plants with large edible unprotected seeds, is a small one in this country ; but it is of especial importance on account of the difficulty the species present when we try to account for their presence in these Islands, except on the hypothesis of a former greater continuity of the land. The difficulty is so real that I have devoted particular attention to the attempt to discover in what manner large soft seeds, which cannot be carried in fur or feathers, and are killed by digestion, can be transported across deserts. It will be shown in Chapter IV. that since suitable climatic conditions came into existence there has been no sufficient change of land or sea to give a continuous land passage from the Continent for these plants—yet, here they are and their presence must be explained.

The British plants to which these remarks particularly apply are the following :—the Oak, Beech, Ash, Maple, Privet, Spindle Tree, Ivy, Flags, Convolvulus, various Mallows, White and Yellow Waterlilies, and Apple. In each of these, except sometimes in the Waterlilies and Apple, the fruit is eaten for the nutriment contained in the seed itself, which is therefore generally destroyed. No doubt in many of these plants the seeds are occasionally dispersed by rivers ; but this will only scatter them along the lower part of the same river-basin or at most some distance along shore ; it will not carry Waterlilies to isolated lakes or to other river basins, nor can dry-soil plants be carried thus to scattered islands.

The largest edible seed we have is the acorn ; if it can be transported freely for considerable distances uninjured, the difficulty in the other cases must be more apparent than real. In peat-mosses, on open chalk downs, and in ploughed fields, often a mile or more from the nearest mature tree, one constantly finds seedling Oaks, which last a few months or, perhaps, a couple of years, and then die, the conditions being unfavourable. I have for several years noted the position of these seedling oaks, finding them in places where no mammal would take the acorns. For instance, they are common in any of the New Forest peat-bogs that are within a mile of an Oak-tree. They are common also in some places on the top of the escarpment of the South Downs, half a mile from Oaks, and 300 or 400 feet above them. They are always associated with empty acorn-husks, stabbed and torn in a peculiar way. In October and November rooks feed in the Oak-trees, and I have long felt convinced that they were mainly responsible for the dispersal of acorns. On October 29th of 1895, in the middle of an extensive field, bordered by an oak-copse and scattered trees, I saw a flock of rooks feeding and passing singly backwards and forwards to the Oaks. On driving the birds away, and walking to the middle of the field, I found hundreds of empty acorn-husks, and a number of half-eaten pecked acorns. It was noticeable that many of them were not shed acorns, but were accompanied by acorn-cups, the stalks of which had been bitten to tear them off the tree. The reason for the selection of acorns in cups is probably that they are easier to carry —a shed acorn must be an awkwardly large and slippery thing for a rook's beak, one with a stalk will be more convenient. Several uninjured acorns were found, one, almost uninjured, had been driven by a single peck deep into the soft soil of a mole-hill.

In this way oak-woods must spread rapidly ; but we still want observations as to the extreme distance to which acorns are thus carried. I have seen seedling Oaks at a distance of a mile from the nearest tree (not necessarily the tree from which the acorn came) and have found the characteristically torn husks somewhat further away.* Mr. J. J. Armistead, moreover, records† that he once found a young Oak in a sheltered ravine among sea-cliffs on the northern coast of Hoy, Orkney. The tree was

* *Nature*, No. 1358, vol. liii., p. 6 (1895).

† *Zoologist*, p. 19 (1891).

over six feet high. A few Rock Doves bred near the place, and he concluded that an acorn had been brought by one of these birds, but where from? Unless it had been picked up on the sea-shore, it must have been carried a long way indeed. It could hardly have been brought by man, as the place was very remote, as well as difficult of access. Rooks occasionally cross the Pentland Firth. The distance of the north of Hoy from the nearest point where Oaks grow is fully as great as is the distance across the Strait of Dover; it is probably more than twice as great as was the gap between England and France at the period when the Oak was re-introduced after the Glacial Epoch. Not only have the cliffs of Dover and of Calais steadily receded through the inroads of the sea, but when the 'submerged forests' flourished both the English and the French Coasts seem to have been bordered by a wide belt of flat land covered with Oaks, the stumps of which are now found rooted in the ancient soil as much as forty feet below the present sea-level.

The transportation of large edible seeds for such long distances uninjured is probably of exceptional occurrence, and is more probably due to rare accidents than to special adaptation. Some years ago I found, for instance, in an old chalk-pit the remains of a wood-pigeon which had met with some accident. Its crop was full of broad-beans, all of which were growing well, though under ordinary circumstances they would have been digested and destroyed. As fully half at least of the birds that are hatched must die by various accidents before the following season, it is evident that this dispersal of the contents of their crops must be of daily occurrence. A pigeon would easily cross the Strait of Dover in half-an-hour, and in the days when raptorial birds and wild cats were plentiful, many must have been struck down with their last meal undigested.

Accidents of this sort, however, are not absolutely necessary for the dispersal of the seeds; for a considerable number, even of such soft seeds as that of the Ivy, are passed with their vitality unimpaired. This is often the case when the bird or other animal has been feeding greedily; and at such times the bird may throw up great part of its food undigested, especially if it is startled.*

Birds, especially young birds, as Professor Lloyd Morgan has shown, learn by experience, and try various unsuitable foods. This must often lead to their eating indigestible, poisonous, or aperient fruits, which are not commonly taken. So many fruits have medicinal qualities that these in many cases may be special adaptations to aid the dispersal of the seeds. The migrating bird in its first year is constantly coming across plants new to it, and this at times when it is too tired and hungry to discriminate.

Mammals also must have greatly aided the dispersal of seeds in former times, for an ox, a deer, or a horse falling over the cliffs of France would tend to drift with the prevalent south-west wind till it was thrown upon the English Coast, where wolves and foxes would pull it to pieces, dragging the remains beyond the reach of the sea, and perhaps burying parts, with the undigested vegetable food still contained in the stomach.

It is needless to multiply instances, enough has been said to show that the special modes of transportation studied by Lyell and Darwin, added to the accumulated accidents of some thousands of years, are sufficient to account for the introduction of the whole of our native plants, without the necessity for any continuous land connexion between the different islands, or with the Continent. Indeed the constant rain of seeds over our Islands is probably on such a scale that were it not for the

* E. M. Langley, *Nature*, December 15th, 1898.

circumstance that most of them must fall on ground that is already occupied, we should continually have to record the introduction of new species. New plants are rarely introduced at the present day, merely because all the species occurring within a reasonable distance have already had their chance, and those that were suited to our climate established themselves long ago. The modern introductions are mainly weeds of cultivation that cannot compete with the native plants on uncultivated ground, or are species from distant lands.

As instances of how readily our native plants will occupy any tract newly made fit for them, I will mention two or three cases that have particularly struck my attention. When the new railway to Cromer was made, the turf and top soil were pared off for a long distance, but nothing more was done for several months. Next summer the route of the new line was marked by a scarlet ribbon, which could be seen stretching across the country, the newly bared sub-soil having been taken possession of by a profusion of poppies. A new embankment on the Bournemouth line near Brockenhurst, again, for several years was gay with corn-marigolds, which have since died down and mostly disappeared. A still more remarkable case is seen in the rapidity with which aquatic plants and animals spread to a newly dug pond. In fact, so continuous is this migration that we can get a fair idea how long a pond has been made, and has contained water, by the number of species of aquatic plants and mollusca that it yields. A mediæval fish-pond or moat contains a much more varied fauna and flora than is found in a newly dug dew-pond on the Chalk Downs, though it is surprising how many species find their way to these ponds.*

* See Reid, 'The Natural History of Isolated Ponds,' *Trans. Norfolk Nat. Soc.*, Vol. V., pp. 272-286 (1892).

CHAPTER IV.

Changes in Geography and Climate.

WHEN we discuss the origin of the British flora or fauna it is impossible to assume, as we can in the case of certain oceanic islands, that the process has been no more than the gradual introduction of the plants, under unchanging climatic conditions, into an area of limited and almost unvarying extent, holding unchanging relations with the nearest land, and till that time unoccupied by any other flora. Both geographical and climatic changes have played an essential part in shaping our flora as we now see it. Moreover, except in part of our country immediately after the retreat of the ice, each plant introduced seems to have been brought into an area already clothed with vegetation, though, under a changing climate, the native plants may have become less adapted for the station than were the intruders. It will be necessary, therefore, to trace out the changes of land and sea which have affected our islands since the existing plants and animals first made their appearance here; though, as was suggested in the last chapter, I greatly doubt whether in islands so near a continent the actual junction or isolation is of such great importance as has been imagined. Plants can certainly overleap barriers more easily than is usually thought. In various indirect ways, however, former geographical changes must greatly have facilitated the dispersal of the species, and a short discussion of the principal changes that can be shown to have taken place may assist in explaining some of the anomalies in geographical distribution.

It is useless for our present purpose to go back to any distant geological period, for in Britain there exists so vast a break in the series of Tertiary strata that we are unable to bridge it. Our Middle Tertiary flora, which can be studied in the Oligocene strata of Hampshire, is a subtropical one, not allied to that now occupying the country. The history of the succeeding Miocene Period in these islands is a complete blank, for we have no fossiliferous deposits of that age, and all we can say is, that the Miocene appears to have been a period of great earth-movement and folding, under which the surface configuration of Britain was completely changed. Whether Britain was then under water or was mainly dry land we do not know. Certain of the Miocene plants found on the Continent are living European species—probably none of them now British—and the flora as a whole begins to show a distinct affinity with that now occupying the southern parts of the Continent.

Throughout the Pliocene Period there is evidence of the slow refrigeration which culminated in the Glacial Epoch; but unfortunately, as far as the botany is concerned, this climatic change cannot be followed, for plants only occur in the newest stage of the period. The whole of the strata of Older Pliocene age yet discovered in Britain are of marine origin, and were laid down at some distance from land in a warm sea. The Coralline Crag of Suffolk yields, however, a few drifted land-shells, and at its base contains bones of land animals, washed out of some older deposit; but there are in it no determinable plant-remains. A few pieces of much decayed worm-eaten drift-wood are all that I have seen, and, as these might well have drifted across the Atlantic with the Gulf Stream, they are of no value for our present inquiry; the rolled fragments of phosphatised or silicified palm-wood in museums do not really belong to the period of the Crag, they are washed out of the underlying London Clay.

During the earlier stages of the Newer Pliocene Period the climate was still somewhat warmer than at the present day, as is indicated by both the marine and the land mollusca. Britain then seems to have taken somewhat its present shape, for we find in our eastern counties traces of a shore-line, parallel to the existing one, and of an adjoining area of dry land, on which flourished various mammals and mollusca. Of the associated plants we as yet know nothing, mainly, I believe, because collectors who examine the Red Crag desire to obtain mollusca or mammals, and do not look for the fruits and seeds, which moreover in a marine deposit, even of littoral origin, are usually rare and badly preserved. The land and fresh-water mollusca of the lower part of the Red Crag are mainly south-European; those of the Upper Red Crag and of later Crag Deposits are more northern—there is still a slight admixture of extinct forms, even in the newest.

Only in the latest deposits belonging to the Pliocene Period can we find a copious land fauna and flora, and, as far as the plants now inhabiting Britain are concerned, history begins with the Cromer Forest-bed; all before is prehistoric and speculative. The so-called Forest-bed consists of a series of estuarine and lacustrine strata, laid down apparently by the ancient Rhine, which at that period seems to have crossed a low area now occupied by the shallow southern half of the North Sea.*

* 'Geology of the Country around Cromer' (1882); 'Pliocene Deposits of Britain' (1890), *Memoirs Geological Survey.*

We cannot speak confidently on the point, but the evidence suggests that the general outline of the British Isles did not greatly differ from that which now holds, the principal difference probably being, that the Strait of Dover had not then been cut, and that England was connected with Belgium and Holland by a wide alluvial plain. The legible records of the period here referred to are confined to the eastern part of the counties of Norfolk and Suffolk, though deposits probably of the same age, but containing no fossils, occur in several other of the eastern and southern counties. At one spot only, outside East Anglia, are fossils apparently of this age to be found. Dewlish, in Dorset, has yielded a few bones of the characteristic elephant, *Elephas meridionalis;* but no other fossils could be discovered. If the deposit is of the same age of the Forest-bed, it certainly suggests that the main contours of the land were already shaped; though most of the valleys, in that region at any rate, are of later date. The climate indicated by the plants and animals of the Cromer Forest-bed is very like that which we now enjoy; the warmth of the Miocene and early Pliocene Periods had passed away, but the cold of the Glacial Epoch had not yet swept off the numerous large mammals, nor transformed the character of the vegetation.

The Pliocene Period, with its temperate and gradually cooling climate, was separated from the present era by a period of which the exact history is still obscure. We know that this Pleistocene Period was characterised by more than one wave of intense cold, which, for a time must profoundly have modified the fauna and flora of Britain. It was also marked by milder intervals, sufficiently long for the temperate plants to re-appear; and also by a period of drought, which brought the fauna of Central Asia into continental Europe, and in a minor degree affected the climate of Britain. Man first appeared in Britain during the latter half of the Pleistocene Period; or rather we should perhaps say, that we have as yet no satisfactory evidence of his earlier incoming.

The physical geography of Britain during the period which saw the formation of the Glacial and Palæolithic deposits is still uncertain in many points. I think, however, that the evidence warrants us in saying that no very great changes affected the boundaries of land and sea. Submergence of part of the land took place; but in the South and East of England at any rate, only to a limited extent, perhaps 150 feet. There was also a time when the land stood at a greater elevation; though in England this elevation above the present level does not appear to have exceeded 70 feet. Coast-lines have also been cut back in the course of time by the incessant action of the waves, and in other places shingle-beaches or sand-dunes have slightly encroached on the sea. But all these changes can scarcely have been sufficient greatly to modify the outline of Britain; though in indirect ways their influence on the flora must have been considerable. The changes which modified the Pleistocene fauna and flora were of an exceptional character; for, besides the enormous fall and the great oscillations in the temperature, the accumulation of vast uninhabitable deserts of ice and snow must have blotted out all plant life over great part of Britain. These deserts must also have affected the migration of the Arctic plants in ways that even yet have been scarcely recognised.

An attempt will be made to give an outline of the succession of events as far as the history can be traced; but it may be necessary to warn readers that I have been led to interpret the records somewhat differently from other geologists. Approaching the subject from the point of view of a naturalist, the comparative importance of the different stages and of the different agencies, and even the reading of the physical geography, will assume an aspect very unlike that ordinarily laid before the student. To the extreme glacialist the 'Pleistocene' is equivalent to the 'Glacial' Period, and the scattered relics of Interglacial mild epochs are judged to be of small importance. It may be thought that the following notes go to the opposite extreme. I believe, however, that the accumulation of ice and snow merely marked two or more culminating epochs in a period when the climate was at least as commonly temperate as Arctic. The geological evidence for this I have already published (see also below 'Hoxne,' p. 77; 'Selsey,' p. 88; 'West Wittering,' p. 94.)

The appearance of man in this country is sometimes thought to mark a new era; but, as far as our present information goes, it was long before he had much influence on the character of the fauna and flora. Palæolithic man was only one more carnivorous animal added to a fauna which already possessed several quite as dangerous, and apparently occurring in greater numbers. He did not cultivate the ground, and therefore would not introduce weeds of cultivation. We do not know whether he often crossed the narrow seas; though it is doubtful whether an occasional canoe, not freighted with vegetable produce, would greatly aid in the dispersal of plants which could be carried by so many other messengers. It was not till Neolithic man appeared, with domesticated animals, cultivated plants, and probably with more seaworthy canoes, that the human race took a leading part in the dispersal of seeds. It still remains to be seen how large a proportion of our plants were unrepresented in Britain before his days.

We have now to trace in a few words the succession of events during this somewhat obscure period. The unmistakably Preglacial records cease, as already observed, with the temperate Cromer Forest-bed. Then succeeds a marine stratum showing a submergence of perhaps fifty feet, which cannot greatly have altered the outline of the country, though at present little is known about this epoch. Next follows a colder period, with Arctic plants ; and as these occur just above the present sea-level, and lie evenly on the strata below without deeply channelling them, the height of the land at the commencement of the Glacial Epoch, in Norfolk at any rate must have been almost the same as it is now.

The freezing of the shallow land-locked North Sea, and the steady accumulation of snow, which could neither escape nor melt sufficiently fast, seems next to have resulted in the formation of an ice-sheet continuous with that pouring down from Norway and the Baltic, and this ice-sheet overspread the east of Britain as far south as the Thames. Whether the Arctic flora had sufficient time thoroughly to occupy Britain before this mantle overwhelmed the lowlands seems somewhat doubtful, for the only routes the plants could follow were across the North Sea, or the more southerly land-passage by the isthmus through which the Strait of Dover has now cut. The absence of any comparatively large-seeded northern plants, such as the Larch, Scandinavian Alder, or Arctic Poppy, either in a recent or in a fossil state, suggests that the small-seeded species that we do find were brought by birds, either across the sea or across the desert of ice, and did not come by land. To this epoch, when the drainage of a large part of Europe was poured into the North Sea, but could not escape northward on account of the ice, belongs probably the severance of England from the Continent, for the water was forced to cut itself a new channel across the low neck of land just beyond the southern limit of the ice-sheet. Other parts of Britain were hidden under ice-sheets whose gathering grounds had other centres, and the result seems to have been the total blotting out of the flora over the area north of the Thames and Severn, with the possible exception of certain high hills which rose above the ice. Even these were probably so smothered with snow that only the steeper crags were bare in summer.

The condition of the greater part of Britain during the climax of the Glacial Epoch will not, therefore, greatly interest the botanist. The flora was so nearly exterminated that the interest is transferred to the non-glaciated strip between the Thames and Severn and the English Channel, and to a very small non-glaciated area in South Wales. In these parts only could the Arctic plants and mammals live, and the whole of Britain was so cold that the temperate species must have entirely disappeared.

Many naturalists will disagree with the statement that has just been made ; for it has become almost an article of faith that there were certain warm corners in these Islands where the Temperate animals and plants could survive, and where the peculiar Lusitanian flora of Cornwall and of the West of Ireland lingered on till the renewed warmth enabled the plants again to spread. It will be necessary therefore briefly to summarise the evidence on which the opinion above expressed has been founded.*

The temperature of the sea and of the air do not necessarily correspond in the same regions ; we will, therefore, first discuss the evidence as to the lowest temperature of the seas round Britain. For this purpose the former southern limit of the formation of shore ice, or 'ice-foot,'

* See 'The Climate of Europe during the Glacial Epoch,' *Natural Science*, Vol. I., No. 6, pp. 427–433 (1892).

ought to give a fairly accurate idea as to the temperature of the water. No doubt a large iceberg may travel a long distance through comparatively warm water before it entirely melts away; but shore-ice, such as forms every winter in the Arctic Regions, once fringed our south coast, and beset the shores of Brittany and of the Channel Islands. When, in the spring, the ice became detached, it transported its burden of included rocks hither and thither, even across the Channel. We thus find on Selsea Bill erratics weighing several tons, but undoubtedly derived from Bognor or from the Isle of Wight. Others, equally large, have come from the Channel Islands and the coast of Brittany; one block of granite is like that of Cornwall. The transportation of large erratic blocks for distances of at least a hundred miles, shows that the temperature of the water in the spring, though sufficiently high to dislodge the ice, was yet too low to melt it rapidly. Even with a strong wind a flat mass of shore-ice would take several days to cross the Channel. In order to compare this ice-laden English Channel with existing seas, it is necessary to travel northward, till we cross the isotherm of 32° F., and are near the Arctic Circle.

Thus far we have dealt solely with the temperature of the sea. We will now turn to the evidence as to the temperature of the air during the same period in the South of England; and for this we can employ both physical and biological data. The country north of the Thames and Severn, buried under ice, must have been bordered by a wide strip of barren land, with dwarf birch and willow, but without trees. In this belt flourished also a mammalian fauna like that now inhabiting similar belts in the Arctic Regions, for in the area lying between the ice-sheet and the ice-cold English Channel it would be impossible to have a mean temperature much above the freezing point.

Remains of this boreal fauna and flora have now been found at several places in the south of England. A large assemblage of Arctic mammals has been discovered near Salisbury, and it includes such thoroughly boreal forms as the Musk Ox, Arctic Fox, and Lemmings. Even in what is now one of the warmest parts of our Islands, Arctic plants occur in the fossil state; for Bovey Tracey, in Devon, yields the Dwarf Birch, and the Bearberry. This leaves no place of retreat within these islands for the Temperate animals and plants. All Ireland was glaciated, so nothing could live there, except perhaps a few Arctic plants on the mountain-tops. All England was under ice, except the extreme south; and there the climate was too cold for temperate plants to live. It may be suggested that the Scilly Islands were warmer, and perhaps they were somewhat better than Devon and Cornwall. But this will not account for the preservation of the Lusitanian Species, for most of them are not found on the Scilly Islands, and plants like the *Arbutus* would be killed by a climate only slightly more severe than that now found in Ireland.

After the passing away of the ice there was a return to genial conditions, which lasted so long that during this 'Inter-glacial' period a series of physical changes took place, and there was time for the Arctic species to die out and for a large Temperate fauna and flora to occupy the country. We do not yet know the history of some of the stages, as there are several gaps in the record; the changes, however, were slow and gradual, allowing time for valleys to be deepened and again silted up, for sea-cliffs to be cut back, and for plants to spread far and wide over new districts. During the greatest intensity of the cold, as we have shown, there seems to have been a submergence of a few feet. Then comes a break for which the records have not yet been discovered. The next stage known shows a submergence of about 140 feet, with a sea slightly warmer than that now washing the coast of Sussex. The marine mollusca are species living in the English Channel at the present day, mixed with a few that do not now range north of the Bay of Biscay. We know nothing of the plants of this stage, and it is probable that the warmth of the sea was mainly the result of its greater depth, which allowed ocean currents more freely to enter.

After this submergence the land rose gradually, the climate apparently remaining unaltered, till we again find freshwater and estuarine deposits, laid down when sea-level must have been the same as at the present day, or slightly lower. These deposits contain a prolific fauna and flora, which includes several southern animals and plants, but no northern ones. Then succeeds another transition stage, about which we at present know very little, followed by a second glaciation, less severe than the former one, or perhaps characterised rather by a dry cold, which did not permit of so great an accumulation of snow and ice, though the northern parts of Britain were again glaciated.

I may be permitted at this point to say a few words on the subject of the recurrence of Glacial Epochs, for it is a matter that closely concerns the student of the geographical distribution of animals and of plants. It will be unnecessary to enter into theoretical questions as to the cause of these climatic oscillations, for they are evidently due to something entirely unconnected with changes in the physical geography of Britain or of Western Europe. These notes are merely a chronicle of the climatic and geographical changes for which we have direct evidence; a true connected history of Britain since it became a recognisable unit cannot yet be written. It will be observed that neither of the doctrines commonly taught seems to be borne out by the evidence above mentioned. We have no indication in our Tertiary or later deposits of a number of alternating Glacial and Interglacial Epochs, such as are required on the theory of Croll * adopted by Professor James Geikie.† On the other hand, the evidence is perfectly clear that this country saw two cold Epochs, and certain indications make one suspect that there may have been a third, less rigorous. The exact succession of events is at present very difficult to follow; for it is unsafe to compare isolated records, which belong to different regions, and may not belong to the same period. We need more excavation and close examination of localities such as Hoxne and the Selsey Peninsula, where several stages can be studied in chronological order, with no possibility of mistakes in the succession.

The wind-borne 'loess' of Central Europe, with its desert or sand-dune mollusca and mammals, belongs apparently to the second cold period just alluded to. Only slight indications of this dry climate have been discovered in Britain, and, though it may have marked an important stage in the building up of our flora, we know little about its plants in the south, while nearer the glaciated area those found are common Arctic forms. It is always difficult to obtain botanical evidence of a bygone period of drought, for desert-plants seldom find their way into lacustrine deposits, and porous sub-aerial deposits like drift-sand or loess are the worst possible for the preservation of plant-remains, though they may be full of calcareous fossils.

The South of England during the second period of glaciation seems to have suffered from dry cold winters, which froze the ground unprotected by snow, and allowed the summer rains to fall on soils rendered impervious by

* *Climate and Time.* † *Great Ice Age.*

deep freezing. This led to enormous and rapid denudation, over areas where the rain now sinks in and is slowly given out as springs. Masses of loose flint and chalk débris were swept off the South Downs and spread out in a wide sheet extending several miles over the lowlands, and over the Interglacial deposits already described. Even in Cornwall the rubbly drift known as 'head' seems to have marked a similar stage. It is difficult to believe that anything but a poor Arctic vegetation could have withstood these conditions, and the Arctic plants of Devon may belong to this cold epoch, rather than to the older one represented by the erratics of Sussex and the Boulder Clay near London. The Arctic mammals found near Salisbury may belong to the same stage, they are migratory or else Steppe species.

The stage that follows — the transition from the Palæolithic to the Neolithic — is unfortunately one of the most obscure, and I can only suggest that the break is more apparent than real, and that one follows the other in close succession. No doubt there is generally a marked difference between deposits of Palæolithic and those of Neolithic age, the older series occupying terraces far above the reach of any flood, while the more recent series lie in the bottoms, or below the bottoms, of existing valleys. It may prove, however, that the climatic change and the difference in the position of the deposits are related as cause and effect, little change having really occurred in the contours of the country. As soon as the climate ameliorated, frozen soil would no longer cause erosion and deposition to act in the peculiar way above described. The older deposits would be left stranded at all elevations, and denudation and deposition would at once change to the ordinary types caused by river action in a Temperate climate. With the climate, the fauna and flora would also change; and at the same time the race of hunters would give place to a higher race that tilled the ground and had domesticated animals. These, however, are merely suggestions; for a systematic study of the deposits of this stage also, at some point where they give a continuous record, will probably solve the riddle.

The Neolithic and later periods do not call for any lengthy description. At first the land stood at an elevation some 60 or 70 feet above its present level, so that many of the river-valleys were cut to that depth below the sea, and much of the English Coast was fringed with a broad strip of alluvium, which probably almost connected our island with Belgium and France. The climate during this epoch was Temperate, for in the lowest 'submerged forests' the Oak is the most abundant tree. Then gradual and intermittent submergence flooded the lower parts of the valleys, and caused them to be silted up by the deposits of rivers that no longer had sufficient fall to scour their beds. In some of the peaty deposits or old vegetable soils that mark stages of rest in their process of submergence, we find polished stone weapons, and relics of cultivated plants and of domesticated animals. The flora of these deposits, however, is still very imperfectly known; but all the plants are species still found in Britain, though the occurrence in South Wales in a 'submerged forest' of *Najas marina*, a plant now confined to Norfolk, shows that the local distribution may have been slightly different.

Since the close of the Neolithic Period, changes in physical geography have been slight, and have consisted mainly in the continuous silting up of the flooded valleys, and in the cutting back of the coast-line by the waves. This latter process, it should be remembered, has been sufficiently marked to increase the width of the Strait of Dover, which in places is also being deepened by the scour of the tides. When our present flora entered the country, at the close of the Glacial Epoch, it was far easier for animals and plants to cross from the Continent than it is now.

The reader will probably rise from the perusal of this chapter with a confused idea of many small changes in the limits of sea and land; which, however, were of no very great importance as bearing on the past history of our flora. This impression is, I believe, the correct one; for, after twenty years' work at deposits belonging to the periods here dealt with, I am greatly impressed with the smallness and multitude of the changes, and with the gradual way in which they occurred, as is demonstrated wherever we can discover continuous records. The climatic changes, on the other hand, though perhaps equally gradual, were most thorough and sweeping; inevitably they must have been accompanied by corresponding changes in the flora.

CHAPTER V.

Deposits containing Fossil Plants.

If we desire to trace out the past history of our native plants, we must study such relics as are preserved in various stratified deposits, especially those of which the geological position can be proved by other evidence. The questions are often asked :—Where are these relics to be found, and what is the method of research adopted? These are questions the answers to which will not be found in any text-book, nor, apparently, are they known to most geologists. It will be useful, therefore, to give a short description of the sort of deposits which have proved most prolific, and of the methods that have usually been adopted to obtain the plant-remains. This will be followed by an account of the fossiliferous strata already examined, with the leading characteristics of each, such as date, nature, and origin of the deposits, general character of the included fauna and flora, notes of any local circumstances which must have affected the plants, and finally, a list of the plants. This will occupy a good deal of space; but it is all information needed by the local geologist or botanist, and will, I hope, aid in the study of past history of the floras of our different counties and districts. References have been added to published authorities, from which a fuller account of the geology and zoology can be obtained; but in every case, unless otherwise stated, I have myself determined the plants included in the lists.

Various points have to be taken into consideration if we desire to avoid failure or useless labour in our search for seeds or leaves in a determinable state. The deposits most likely to yield satisfactory results are not such as one would at first sight select as best for the purpose. On consideration, it will readily be understood that a wide-spread peat-moss will yield little but remains of bog-plants; an extensive lacustrine deposit will contain few but aquatic species; a broad alluvial flat may only preserve plants of the marsh and wet meadow. The work of collecting at best is very laborious, and, in order to obtain with the least amount of trouble an insight into the fossil botany of any particular period or district, it is best, where practicable, to select for examination the deposits of a small stream which flowed through a varied country. These will yield not only seeds of the aquatic and marsh plants that lived on the spot, but also of a variety of dry-soil plants and trees which grew on sandy or rocky banks overhanging the channel. They will also yield seeds of numerous species which grew somewhat further away, and were brought by birds and dropped from the overhanging boughs; and will contain winged seeds transported by the wind.

It may be thought that plants of all these descriptions will be found in a lake or peat-bog, and no doubt it is so; but they will be so rare, and mixed with so large a proportion of seeds belonging to some few aquatic plants, that the time spent in searching for them will be largely increased. I speak of this from personal experience; for, through an imperfect appreciation of this difficulty, much time was lost in my earlier work, and samples of clay, collected and washed with great labour, often yielded nothing but thousands of seeds belonging to half a dozen aquatic plants, which were already quite well known. As an example, we may take the flora of the Cromer Forest-bed, which is still a small one, for the deposits belonging to it are parts of a wide-spread alluvial plain, with shallow pools and broads. Yet the collection of the plants has given me ten times the trouble that was needed to obtain a much larger number of species at West Wittering. This latter deposit is of estuarine origin—it therefore contains mingled fresh-water, estuarine, and sea-coast plants; it is the deposit of a very small stream—the proportion of dry-soil species is therefore exceptionally large, and their seeds are unusually well preserved; moreover, the stream within a mile crossed the edges of a most varied series of strata, including chalk, stiff clay, loose sand, marl, loam, and gravel—the flora is therefore as good an epitome of that of the surrounding district as could be obtained by the examination of several deposits, each of which only fulfils some of these conditions. It may be added that, while the best fossiliferous deposits in the Forest-bed are commonly stiff clays or peaty-beds, difficult to take to pieces without injury to the fossils, the strata at West Wittering are sandy loams, which, when dried and placed in a sieve in water, quickly fall to pieces and leave the seeds uninjured.

Deposits like that just mentioned, though giving the best general view of the flora of a district, are unsatisfactory in certain respects; for they seldom yield well-preserved leaves, and many species having soft seeds can only be recognised by the leaves. In order to discover leaves of any plants, other than the small tough-leaved Arctic ones, it is commonly necessary to split up laminated lacustrine clays, or masses of bog-iron ore; but, unfortunately, Pleistocene clays are seldom sufficiently firm to allow of handling in this way. Or else we must search the masses of tufa deposited by calcareous springs; for these yield beautifully preserved casts of deciduous leaves, and may also contain impressions of the succulent leaves of non-deciduous plants; they are almost useless, however, for the study of seeds, which are generally too small to be recognisable in hollow impressions in a somewhat coarse-grained matrix.

Want of time has prevented me from undertaking so thorough an examination of the plants of the newest deposits as they deserve, or as has been made in Sweden by Professor A. G. Nathorst and Dr. Gunnar Andersson. We happen, however, to possess a large series of deposits of somewhat earlier date than any of those found in Scandinavia; it seems best, therefore, to devote attention more particularly to the plants contained in them. Preglacial plants are extremely rare in Europe, and the Interglacial flora has only been studied at a few localities in North Germany, principally by Dr. Carl Weber and Professor A. Nehring.

It only remains to add a few words as to the position in time of the various deposits to be described. They are here divided into Preglacial, Early Glacial, Interglacial, Late Glacial, and Neolithic. The whole of the historic period, from the invasion of the Romans downwards, has purposely been omitted, not because it is of little importance in the history of the flora as we now see it, but because collecting has not yet been done with sufficient accuracy to fix the century to which the deposits belong. Without this, the identification of the included plants would be of little value. One exception only has been made. A certain number of plants from Silchester are mentioned, as these were found in carefully selected material obtained by Mr. A. H. Lyell during excavations at the Roman town, and were certainly contemporaneous with the Roman occupation.

It is quite possible that more than one Interglacial Period is represented in the deposits and plants that I have examined; but the classification has been kept purposely as simple as possible. It so happens, also, that the most prolific of the Interglacial deposits in the South and East of England all seem to fall into a single period—that immediately succeeding the greatest intensity of the cold. Those that remain have at present yielded so poor a flora, which consists so exclusively of species of wide range, that from a botanical point of view they are of little importance. The botanical characteristics of the different periods may be summarised thus:—

PREGLACIAL (latest Pliocene).

Found on the coasts of Norfolk and Suffolk.

Plants are aquatic and wet-meadow species and forest trees.

All yet known are now natives of Britain except *Trapa natans*, *Najas minor*, and *Picea excelsa*.

Associated with many large mammals, the majority of which are now extinct.

EARLY GLACIAL.

Found at a few localities on the Norfolk coast.

Northern plants, including *Salix polaris* and *Betula nana*; no forest trees except Birch and Alder.

INTERGLACIAL.

Southern and Eastern Counties (Hoxne beds D and E, Hitchin, Grays, Selsey, Stone, West Wittering; also Deuben, Grünenthal, Klinge, Fahrenkrug, Lauenburg, Honerdingen).

Plants still living in the same district, mixed with a few southern forms, those already determined being *Acer monspessulanum*, *Najas graminea*, and *Najas minor*, and in Germany *Brasenia purpurea*.

No northern species.

The associated mammals and mollusca suggest a climate somewhat drier and sunnier than that now possessed by the South of England.

Late Glacial.

Throughout Scotland and England as far south as London and Devonshire. (Crianlarich, Hailes, Corstorphine, Bridlington, Hoxne bed C, London, Bovey Tracey, &c.)

Numerous Arctic plants, all of which, except *Salix polaris*, are still to be found on the mountains of Scotland.

Neolithic.

Including 'submerged forests' and early peat mosses. (Hailes upper bed, Redhall, Woolwich, Blashenwell, Barry Docks, &c.)

Flora Temperate. Cultivated plants and weeds of cultivation occasionally appear. Extensive Oak forests. Pine common in the South of England. This flora is better known in Scandinavia than in Britain; it has been divided by Swedish and Danish botanists into several stages characterised by different trees (see p. 92).

Space will not allow me to give in full the evidence on which the deposits are referred to different periods. Where possible, the stratigraphical position has been studied; but in certain cases where direct evidence of superposition is not available I have dated the deposits according to the affinities of the included fauna and flora. The animals are, for this purpose, of more value than the plants, for they change more rapidly; plants, however, yield the best evidence of former climate. It will be seen that the date of certain of the deposits is unmistakable; and particular attention having been devoted to these and to their included plants, any doubt as to the age of the remainder is of comparatively little consequence botanically—nearly all their plants can be authenticated from specimens found in deposits of known age. The localities are placed in alphabetical order, partly as being most convenient, partly to avoid any appearance of forcing the correlation, as might be suggested if they were here grouped into periods. The principal foreign localities are added for purposes of comparison; but I have seen few of the plants from these. It will be noticed that in the German Interglacial deposits *Brasenia purpurea*, a water-lily not now living in Europe, is a common fossil, though it has not yet been discovered in Britain.

Admiralty Offices, London.

(Abbott, 'The Section exposed in the foundations of the New Admiralty Offices,' *Proc. Geol. Assoc.*, Vol. XII., pp. 346–356. 1892.)

Associated with or below remains of Mammoth, Hippopotamus, and Rhinoceros are found a few plants, the only determinable species being:—

Betula nana. Ceratophyllum demersum.

Airdrie, Lanark.

(Dunlop, 'Note on a Section of Boulder-clay, containing a Bed of Peat,' *Trans. Geol. Soc. Glasgow*, Vol. VIII., pp. 312–314. 1888.)

The peat is classed as Interglacial on account of its occurrence between two beds of Boulder-clay. It contains beetle-remains and the following species of plants:—

Ranunculus aquatilis.	Betula nana.
Prunus Padus.	Empetrum nigrum
Potentilla Comarum.	Potamogeton.
Hippuris vulgaris.	Carex dioica.
Apium nodiflorum.	——– panicea.
Carduus.	——– rostrata.
Menyanthes trifoliata.	Isoetes lacustris.

Albert Dock, North Woolwich, Essex.

(Spurrell, 'On the Estuary of the Thames and its Alluvium,' *Proc. Geol. Assoc.*, Vol. XI., pp. 210–230. 1889.)

A 'Submerged Forest' and peat bed beneath the Roman layer yields the following plants:—

Cornus sanguinea.	Quercus Robur sessiliflora.
Betula alba.	Taxus baccata.
Alnus glutinosa.	Phragmites communis.
Corylus Avellana.	

Allenton, near Derby.

(Arnold-Bémrose, 'Discovery of Mammalian Remains in the Old River-gravels of the Derwent near Derby, *Quart. Journ. Geol. Soc.*, Vol. LII., pp. 497–500. 1896.)

The plants were found associated with Hippopotamus (apparently a whole skeleton), Elephant and Rhinoceros. This fauna is probably Interglacial.

Ranunculus aquatilis.	Valeriana officinalis.
———— sceleratus.	Eupatorium cannabinum.
———— Flammula.	Leontodon autumnalis.
———— repens.	Taraxacum officinale.
———— bulbosus (?).	Ajuga reptans.
———— Sardous.	Atriplex.
Viola palustris.	Eleocharis palustris.
Montia fontana.	Scirpus pauciflorus.
Rubus Idæus.	Carex.
Potentilla.	Isoetes lacustris.
Hydrocotyle vulgaris	

Bacton, Norfolk.

(Reid, 'Pliocene Deposits of Britain,' *Memoirs Geol. Survey*, 1890; Reid, 'Geology of the Country around Cromer,' *Memoirs Geol. Survey*, 1882.)

The Cromer Forest-bed at Bacton yields cones of *Pinus sylvestris* and *Picea excelsa*, and rhizomes of *Osmunda;* the principal fossiliferous localities are, however, close to Ostend Gap, a short distance to the south-east, and are described under that heading.

Ballaugh, Isle of Man.

('Report of Committee on Irish Elk Remains in the Isle of Man,' *Rep. Brit. Assoc.* for 1897, p. 346. 1898.)

The deposits examined were as follows, Bed A being the most recent:—

A. Peat, with caddis cases and eggs of insects.

Ranunculus Flammula.	Hydrocotyle vulgaris.
Potentilla Tormentilla.	Potamogeton.

B. Sand without fossils.

C. Sandy silt with *Lepidurus* (*Apus*) *glacialis.*

Ranunculus aquatilis.	Carex.
Poterium officinale.	Schœnus (?).
Salix herbacea.	

D. Loamy Peat.

Ranunculus aquatilis.	Littorella lacustris.
——— Flammula.	Potamogeton crispus.
——— repens.	Carex.

E. Gravel without fossils.

F. Chara Marl with *Megaceros hibernicus.*

Ranunculus aquatilis.	Potamogeton natans.
——— Flammula.	——— sp.
——— repens.	Carex.
Littorella lacustris.	Chara, 2 sp.
Empetrum nigrum.	

A is Recent or Neolithic. C, from the occurrence of *Salix herbacea* and *Apus glacialis*, is classed as Late Glacial. D and F are provisionally classed with C, but may belong to a milder, Interglacial, period. These deposits, and those found at Close y Garey, occupy silted-up hollows in the glacial gravel. It is not yet clear whether the poverty of the flora, and the entire absence thus far of remains of dry-soil plants, is due to the barren water-logged character of the gravel-flat, or is characteristic of the flora of the Isle of Man at these periods.

Barry Docks, Glamorgan.

(Strahan, 'On submerged Land-surfaces at Barry, Glamorganshire. With Notes on the Fauna and Flora by Clement Reid,' *Quart. Journ. Geol. Soc.*, Vol. LII., pp. 474–489. 1896.)

The newest of these, about 4 feet below mean tide, yielded a polished Neolithic implement and also, according to Mr. Storrie, logs of Willow, Pine, and Oak. An associated shell-marl was full of freshwater shells and seeds of:—

Rumex crispus.	Potamogeton.
Atriplex.	Najas marina.
Salix (leaves).	Chara, 2 species.

Najas marina is now confined to east Norfolk.

The second peat, or land-surface, is composed mainly of sedges (*Scirpus maritimus*) and lies about 9 feet below mean-tide level.

The third peat is composed of large timber and matted Sallow and Reed, with seeds of *Valeriana officinalis* and *Carex*. It lies 20 feet below Ordnance Datum, but shows no sign of the influence of salt water.

The fourth peat is a true submerged land-surface, full of Oak-roots in place, indicating a soil above the reach of the sea. It lies 35 feet below mean tide level, and points to a subsidence of fully 55 feet. The plants are:—

Cratægus Oxyacantha.	Quercus Robur.
Cornus sanguinea.	Salix Caprea.
Corylus Avellana.	Sparganium.

The whole of the deposits belong in all probability to the Neolithic Period.

Beeston, Norfolk.

(Reid, 'Piocene Deposits of Britain,' *Mem. Geol. Survey.* 1890; Reid, 'Geology of the Country around Cromer,' *Mem. Geol. Survey.* 1882.)

Two distinct plant-bearing deposits are represented at Beeston. The lower is a peaty loam full of seeds of Temperate plants, and belongs to the Preglacial Cromer Forest-bed. The upper, and newer, is an Early Glacial stratified loam with leaves of Arctic plants, at the base of the Boulder Clays. At one spot an intermediate deposit is perhaps represented; this is here classed as the base of the Arctic bed.

Plants from the Cromer Forest-bed:—

Thalictrum flavum.	Alnus glutinosa.
Ranunculus aquatilis.	Ceratophyllum demersum.
——— repens.	Stratiotes aloides.
Nuphar luteum.	Alisma Plantago.
Stellaria aquatica.	Potamogeton pectinatus.
Poterium officinale.	——— trichoides.
Hippuris vulgaris.	——— heterophyllus.
Œnanthe Phellandrium.	Najas marina.
Carduus.	Scirpus pauciflorus (?).
Stachys palustris.	——— caespitosus.
Atriplex patula.	——— fluitans (?).
Rumex Acetosella.	Carex (several sp.).
——— maritimus.	Isoetes lacustris.
Betula alba.	

Plants from the base of the Arctic bed :—

Thalictrum minus (?).
Ranunculus aquatilis.
Rubus Idæus.
Poterium officinale.
Hippuris vulgaris.
Myriophyllum spicatum.
Galium boreale (?).
Tanacetum vulgare.
Menyanthes trifoliata.
Rumex maritimus.
Betula nana.
Alnus glutinosa.
Ceratophyllum demersum.
Zannichellia palustris.
Eleocharis palustris.
Scirpus lacustris.
Isoetes lacustris.

Plants of the Arctic bed :—

Salix polaris.

Black Burn, East Tarbet.

From the Clyde Beds at this place Mr. David Robertson obtained seeds of *Rubus Idæus*. The sub-Arctic character of the associated marine mollusca causes these deposits to be here classed as Late Glacial.

Blashenwell, Dorset.

(Reid, 'An Early Neolithic Kitchen-midden and Tufaceous Deposit at Blashenwell, near Corfe Castle,' *Proc. Dorset Field Club*, Vol. XVII., pp. 67–75. 1897.)

The calcareous tufa contains only recent species of mammals and mollusca, with charcoal and unpolished flint implements of early Neolithic type. The plant-remains are impressions of leaves and twigs, with decayed wood and hazel-nuts. The only determinable plants found were :—

Ulmus montana (?).
Corylus Avellana.
Quercus Robur.

Bovey Tracey, Devon.

(Pengelly and Heer, 'On the Lignite Formation of Bovey Tracey,' *Phil. Trans.*, Part II. 1862 ; Nathorst, 'On the Distribution of Arctic Plants during the Post-glacial Epoch,' *Journ. Bot.*, n. s., Vol. II., p. 225. 1873.)

Some clays overlying the Eocene lignite deposits have yielded a few Arctic plants. It is not clear whether these should be classed as Early or Late Glacial. They yield:—

Arctostaphylos Uva-ursi.	Salix cinerea.
Betula alba.	Pinus.
——— nana.	

Bridlington, Yorkshire.

(Nathorst, 'Ueber neue Funde von fossilen Glacial-pflanzen,' *Engler's Bot. Jahrb.*, 1881, p. 431.)

A hollow in the boulder-clay, filled with peaty marl, is here classed as Late Glacial from its stratigraphical position and the occurrence in it of *Betula nana.*

Broughton, Edinburgh.

From a peaty deposit at this spot Mr. James Bennie has recently obtained a few plants, probably of the same date as those from the Neolithic deposits at Hailes and Redhall. There is nothing characteristic in the list:—

Ranunculus aquatilis.	Polygonum aviculare.
——— Flammula.	——— Persicaria.
——— Lingua.	Rumex.
——— repens.	Potamogeton.
Stellaria media.	Scirpus setaceus.
Montia fontana.	Eriophorum.
Carduus.	Carex.
Atriplex (?).	

Caerwys, Flintshire.

(Maw, 'On the occurrence of extensive Deposits of Tufa in Flintshire,' *Geol. Mag.*, Vol. III., p. 253. 1866; Strahan, 'Geology of Flint, Mold, and Ruthin,' p. 150, *Mem. Geol. Survey.* 1890.)

An extensive deposit of calcareous tufa at this place is full of leaves; but the date cannot be fixed, as the tufa is still being formed. The part from which the leaves were collected is probably of Neolithic age.

Pyrus Aucuparia.	Salix cinera.
Hedera Helix.	—— Caprea.
Betula alba.	Populus tremula.

Casewick, Lincolnshire.

(Morris, 'On some Sections in the Oolitic District of Lincolnshire,' *Quart. Journ. Geol. Soc.*, Vol. IX., p. 317. 1853; Reid, 'Pleistocene Plants from Casewick . . . .' *ibid.* Vol. LIII., pp. 463, 464. 1897.)

An ancient alluvial deposit fills a channel in Oolite. The age is uncertain, as there is nothing peculiar among the fossils. Though here classed as Neolithic it may be of older date.

Nuphar luteum.	Rumex crispus.
Galium Aparine.	Ceratophyllum demersum.
Atriplex patula.	Scirpus lacustris.

Close y Garey, Isle of Man.

('Report of Committee on Irish Elk Remains in the Isle of Man,' *Rep. Brit. Assoc.* for 1898, p. 550. 1899.)

The deposits occupy a silted-up hollow, like that at Ballaugh, in glacial gravel. The plants are :—

B. Peat :—

Ranunculus Flammula.	Carduus crispus.
Viola palustris.	Menyanthes trifoliata.
Rubus fruticosus.	Empetrum nigrum.
Potentilla Tormentilla.	Potamogeton.
———— Comarum.	Carex, 4 sp.

C. Megaceros-marl :—

Ranunculus repens.	Empetrum nigrum.
Viola palustris.	Potamogeton.
Potentilla Comarum.	Carex, 4 sp.
Myriophyllum spicatum.	Chara.
Rumex obtusifolius.	

E. Loam at the base of the marl :—

Betula alba.	Carex.
Potamogeton.	

B is Recent or Neolithic. C and E correspond with the marl at Ballaugh (which see), and are classed provisionally as Late Glacial.

Corstorphine, near Edinburgh.

(Bennie, 'Arctic Plants in the old Lake Deposits of Scotland,' *Ann. Scot. Nat. Hist.*, 1894, pp. 46–52.)

In the lower part of the lacustrine deposits filling a silted-up lake are numerous seeds and leaves of Arctic plants. The deposit is probably Late Glacial, and contemporaneous with those of Hailes and Dronachy.

Ranunculus aquatilis.	Menyanthes trifoliata.
——— repens.	Oxyria digyna.
Viola palustris.	Betula nana.
Stellaria media.	Salix repens.
Rubus.	—— herbacea.
Dryas octopetala.	—— polaris.
Potentilla.	—— reticulata.
Poterium officinale.	Empetrum nigrum.
Hippuris vulgaris.	Potamogeton.
Myriophyllum spicatum.	Eleocharis palustris.
Taraxacum officinale.	Scirpus pauciflorus.
Andromeda Polifolia.	——— lacustris.
Loiseleuria procumbens.	Carex, 2 sp.

Corton, Suffolk.

(Reid, 'Notes on the Sections at Corton, seen during the recent visit of the members of the Geological Congress,' *Trans. Norfolk Nat. Soc.*, Vol. IV., pp. 606–609. 1889.)

A bed of lignite and clay, belonging to the Preglacial Cromer Forest-bed, here yields abundant seeds.

Thalictrum flavum.
Ranunculus.
Nuphar luteum.
Hydrocotyle vulgaris.
Œnanthe.
Solanum Dulcamara.
Atriplex patula.
Alnus glutinosa.
Ceratophyllum demersum.
Stratiotes aloides.
Sparganium ramosum.
Potamogeton lucens.
——— trichoides.
Zannichellia palustris.
Scirpus pauciflorus.
——— lacustris.
Eriophorum angustifolium.
Carex.

COWDEN GLEN, RENFREWSHIRE.

(Geikie, 'Great Ice Age,' 3rd edit., pp. 102–104. 1894; Bennie, 'On Things New and Old from the Ancient Lake of Cowdenglen, Renfrewshire,' *Trans. Geol. Soc. Glasgow*, 1891, pp. 213–225.)

This deposit has given rise to much discussion, Professor James Geikie, Mr. Bennie, and others maintaining that the peat is Interglacial and interbedded between two masses of boulder-clay. Some writers, however, consider the upper boulder-clay to be merely a landslip. The plants have a recent appearance, and include the Opium Poppy, a species cultivated in Neolithic times. I think it safer, therefore, not to consider them older than the Neolithic period.

Ranunculus aquatilis.
——— Flammula.
Papaver somniferum.
Viola.
Montia fontana.
Rubus Idæus.
Poterium officinale.
Hippuris vulgaris.
Myriophyllum spicatum.
Galium palustre.
Menyanthes trifoliata.
Pedicularis palustris.
Galeopsis Tetrahit.
Ajuga reptans.
Polygonum lapthifolium.
Rumex crispus.
Betula alba.
Corylus Avellana.
Salix repens.
Pinus sylvestris.
Alisma Plantago.
Potamogeton perfoliatus.
——— pusillus.
——— pectinatus.
Scirpus lacustris.
——— pauciflorus.
Carex rostrata.
Isoetes lacustris.
Chara.

CRIANLARICH, PERTHSHIRE.

Peaty loam with leaves of Arctic plants was found in a railway cutting, and a sample given to me by Mr. J. R. Dakyns yielded the subjoined species. The exact relation of the deposit to the old moraines is not perfectly clear, though the plant-bed would seem to be the newer of the two, and therefore Late Glacial.

Dryas octopetala.	Salix herbacea.
Betula alba.	—— reticulata.
—— nana.	Empetrum nigrum.
Salix repens.	

CROMER, NORFOLK.

(Reid, 'Pliocene Deposits of Britain,' *Mem. Geol. Survey.* 1890; Reid, 'Geology of the Country around Cromer,' *Mem. Geol. Survey.* 1882.)

The Preglacial Cromer Forest-bed at Cromer itself is mainly of estuarine origin, and yields therefore only drift-wood and cones of Scotch and Spruce Firs. About three-quarters of a mile north-west of Cromer black mud belonging to the lower part of the Forest-bed is full of aquatic plants. The species are:—

Ranunculus aquatilis.	Potamogeton prælongus.
Myriophyllum spicatum.	Eriophorum angustifolium.
Potamogeton lucens.	

A full list of plants from the Cromer Forest-bed of all localities will be found in the Table, p. 171.

CROSSNESS, ESSEX.

(Spurrell, 'On the Estuary of the Thames and its Alluvium,' *Proc. Geol. Assoc.*, Vol. XI., pp. 210–230. 1889.)

Two beds of peat or 'submerged forest' are here met with beneath the estuarine deposits of the Thames and underlying the Roman layer. The deposits are synchronous with those at Tilbury and at the Albert Dock.

(L.—*Lower Peat.* U.—*Upper Peat.*)

Ranunculus sceleratus	L.	Sambucus nigra .	L. U.
———— repens .	L. U.	Viburnum Opulus .	L. U.
Oxalis Acetosella .	U.	Fraxinus excelsior .	L. U.
Ilex Aquifolium .	L. U.	Polygonum Hydropiper	L.
Acer campestre .	L. U.	Mercurialis perennis .	L. U.
Prunus communis .	L. U.	Betula alba . .	L. U.
——— domestica .	U.	Alnus glutinosa . .	L. U.
——— Avium . .	L. U.	Corylus Avellana .	L. U.
Rubus fruticosus .	L. U.	Quercus Robur. .	L. U.
Rosa . . .	L. U.	Salix . . .	U.
*Pyrus communis .	L. U.	Taxus baccata . .	L. U.
Cratægus Oxyacantha	L. U.	Iris Pseudacorus .	U.
Hippuris Vulgaris .	U.	Sparganium ramosum	L. U.
Œnanthe Phellandrium	U.	Scirpus lacustris .	L.
Hedera Helix . .	L. U.	Phragmites communis	L. U.
Cornus sanguinea .	L. U.		

Deuben, Saxony.

(Nathorst, ' Die Entdeckung einer fossilen Glacialflora in Sachsen, am äussersten Rande des nordischen Diluviums,' *Kongl. Vetenskaps-Akad. Förh.*, 1894, pp. 519–544.)

Arctic plants are here found nearly as far south as Lat 50°. The species recorded are :—

Batrachium confervoides (?).	Polygonum viviparum.
Stellaria graminea (?).	Salix herbacea.
Saxifraga oppostifolia.	—— retusa.
———— Hirculus.	—— myrtilloides.
———— aizoides.	—— arbuscula (?).

Dronachy, Fife.

(Bennie, ' Arctic Plant-beds in Scotland,' *Ann. Scottish Nat. Hist.*, 1896, pp. 53–56.)

Lacustrine deposits, like those of Hailes and Corstorphine, were laid open during the construction of a new

* Determined by Prof. Marshall Ward from wood.

railway about half a mile from Auchtertool. The plants sent to me by Mr. Bennie were:—

Thalictrum flavum (?).	Salix polaris.
Ranunculus aquatilis.	—— reticulata.
Viola palustris (?).	Empetrum nigrum.
Hippuris vulgaris.	Potamogeton, 2 sp.
Œnanthe.	Eleocharis palustris.
Menyanthes trifoliata.	Scirpus pauciflorus.
Betula nana.	——— fluitans (?).
Salix herbacea.	Carex, 2 sp.

Drope, Glamorgan.

My colleague Mr. Cantrill has obtained some seeds and freshwater shells from beds of peat and marl in a railway cutting near Cardiff. There is nothing characteristic among the fossils, though the assemblage and the relations of the deposits both suggest the Neolithic period.

Viola palustris (?).	Potamogeton heterophyllus (?).
Hippuris vulgaris.	Potamogeton natans.
Menyanthes trifoliata.	Carex.
Betula alba.	Chara.
Juncus (?)	

Dursley, Gloucester.

The calcareous tufa used for building is full of leaves; but, as the tufa is still forming, it is difficult at present to date the different parts of the sheet. Leaves of Hazel, Elm, and Hartstongue were found by Miss M. A. Reid and myself.

Elie, Fife.

(Bennie and Scott, 'The Ancient Lake of Elie,' *Proc. R. Phys. Soc*, *Edinburgh*, Vol. XII., pp. 148–170. 1893.)

The occurrence of bones of Sheep and Rabbit, with capsules of Flax and seeds of Fool's Parsley, suggests that the lacustrine deposit of Elie is not older than the Neolithic period. The flowering plants are :—

Ranunculus aquatilis.	Valeriana officinalis.
——— Flammula.	Cnicus lanceolatus.
——— repens.	Menyanthes trifoliata.
Viola (?).	Ajuga reptans.
Lychnis alba.	Atriplex patula.
——— diurna (?).	Polygonum Persicaria.
Stellaria media.	Corylus Avellana.
Linum.	Iris Pseudacorus.
Rubus Idæus.	Potamogeton.
Potentilla Tormentilla.	Carex, several species.
Hydrocotyle vulgaris.	Phragmites (?).
Æthusa Cynapium.	Chara.

Endsleigh Street, London.

(Hicks, 'On the Discovery of Mammoth and other Remains in Endsleigh Street . . . .' *Quart. Journ. Geol. Soc.*, Vol. XLVIII., pp. 453–468. 1892.)

A clayey loam containing bones of Mammoth and numerous seeds, fills the lower part of a hollow eroded in the London Clay. From its position at the base of the Drift, and its resemblance to other deposits in the neighbourhood of London, it is most probably Interglacial, though newer than the boulder-clay of Middlesex.

Ranunculus aquatilis.	Rumex obtusifolius.
——— sceleratus.	Luzula (?) maxima (?).
——— repens.	Potamogeton obtusifolius.
Stellaria media.	——— crispus.
Geranium.	Zannichellia palustris.
Potentilla Tormentilla.	Eleocharis palustris.
Hippuris vulgaris.	Carex dioica.
Myriophyllum spicatum.	——— 2 sp.
Polygonum aviculare.	Chara.
——— Persicaria.	

Fahrenkrug in Holstein.

(Weber, 'Ueber die diluviale Flora von Fahrenkrug in Holstein,' *Engler's Bot. Jahrb.*, Beiblatt 43. 1893.)

The deposits described are apparently of Interglacial date. Like those of Lauenburg and Klinge, they yield seeds of *Brasenia purpurea*, a plant which has not yet been found fossil in Britain. Its recent range is very wide, though it does not include any part of Europe.

Nuphar luteum.	Ceratophyllum submersum.
Nymphæa alba.	——— ——— demersum.
Brasenia purpurea.	Taxus baccata.
Tilia platyphyllos.	Pinus sylvestris.
Acer campestre.	Picea excelsa.
Vaccinium uliginosum.	Stratiotes aloides.
———— Oxycoccus.	Typha.
Fraxinus.	Potamogeton natans.
Menyanthes trifoliata.	Najas major.
Myrica Gale.	Scirpus lacustris.
Betula.	——— sp.
Alnus.	Eriophorum vaginatum.
Quercus sessiliflora.	———— angustifolium (?).
Corylus Avellana.	Carex echinata.
Fagus sylvatica.	——– Goodenoughii (?).
Salix aurita.	Phragmites communis.
—— cinerea.	Aira cæspitosa (?).

Faskine, Lanark.

(Bennie, 'On the occurrence of Peat with Arctic Plants in Boulder Clay at Faskine, near Airdrie, Lanarkshire,' *Trans. Geol. Soc. Glasgow*, Vol. X., pp. 148–152. 1895.)

The Boulder Clay here contains masses of transported peat full of moss and leaves of Arctic willows. Though here provisionally classed as Interglacial, they may perhaps be of the same date as the Late Glacial deposits of Hailes and Corstorphine.

Viola palustris.	Salix herbacea.
Stellaria.	Sedges—3 or 4 species.
Potentilla (?).	Isoetes lacustris.
Hippuris vulgaris.	

Fenland.

(Skertchly, 'Geology of the Fenland,' p. 320, *Mem. Geol. Survey.* 1877; Miller and Skertchly, 'The Fenland past and present,' p. 341. 1878.)

The peat and 'submerged forests' of the Fenland yield numerous remains of trees. The following list of the plants was compiled by Mr. A. Bell, but I have not seen the specimens, and cannot trace the authorities for some of the species. *Betula nana* is unrecorded elsewhere in deposits of so recent a date.

Fraxinus.	Salix Caprea.
Ulmus.	—— repens.
Betula alba.	Taxus baccata.
—— nana.	Pinus sylvestris.
Quercus Robur.	Juncus aquaticus.
Fagus sylvatica.	Lastræa.

Fillyside, near Edinburgh.

(Bennie, 'The Raised Sea-Bottom of Fillyside.' *Proc. R. Phys. Soc. Edinburgh*, Vol. XI., pp. 215–237. 1892.)

Some drifted seeds occur associated with the marine shells. The deposit is here classed provisionally as Neolithic, for the fauna and flora consists entirely of recent British forms, without the Arctic species found in the Clyde Beds.

Ranunculus Flammula.	Taraxacum officinale.
———— repens.	Stachys palustris.
Viola.	Ajuga reptans.
Lychnis diurna (?).	Atriplex patula.
Stellaria media.	Rumex.
Montia fontana.	Mercurialis perennis.
Rubus Idæus.	Alnus glutinosa.
Sambucus nigra.	Carex.

Garvel Park, Greenock.

(Robertson, 'On the Post-tertiary Beds of Garvel Park, Greenock.' *Trans. Geol. Soc. Glasgow*, Vol VII., pp. 1–37. 1881.)

Marine clays belonging to the Clyde Beds contain a sub-Arctic fauna, and are therefore classed as Late Glacial; they ought, perhaps, to be included in the Neolithic series, for dug-out canoes are stated to have been found at some places in these clays. The plants from Garvel Park sent to me by Mr. Thomas Scott do not suggest an Arctic climate, such as is apparently indicated by the marine fauna.

Ranunculus repens.	Bartsia Odontites.
Lychnis Flos-cuculi.	Atriplex patula.
Rubus Idæus.	Rumex crispus.
Œnanthe Lachenalii.	Sparganium ramosum (?).
Taraxacum officinale.	Isoetes lacustris.

Gayfield, Edinburgh.

From a peaty deposit Mr. James Bennie has recently obtained a number of leaves and seeds. At this locality, as at Hailes, two different plant-beds are apparently represented. The three Arctic Willows suggest a climate like that of the North Cape; the Hawthorn and Wild-Cherry point to a climate as mild as that now possessed by the Scottish Lowlands.

Ranunculus aquatilis.	Atriplex (?).
——— repens.	Polygonum Persicaria.
Viola palustris.	Salix polaris.
Prunus Avium.	—— herbacea.
Rubus Idæus.	—— reticulata.
Cratægus Oxyacantha.	Potamogeton crispus.
Myriophyllum.	——— sp.
Carduus.	Carex.
Sonchus arvensis.	Phragmites.
Menyanthes trifoliata.	Isoetes.

GRAYS, ESSEX.

(Tylor, 'On Quarternary Gravels,' *Quart. Journ. Geol. Soc.*, Vol. XXV., p. 83. 1869; Reid, 'Pleistocene Plants from Casewick, Shacklewell, and Grays,' *ibid.* Vol. LIII., p. 464. 1897.)

The plants collected by Prestwich occur associated with or below the remains of Mammoth and *Corbicula fluminalis.* They point distinctly to a temperate climate and mild winters, for the Ivy is extremely sensitive to winter cold. Both the character of the flora and the position of the deposit suggest correlation with the temperate plant-beds of Hoxne, which lie between the Boulder Clay and the deposit with Arctic species.

Ranunculus repens.	Populus canescens (?).
Rubus fruticosus.	Salix sp.
Rosa.	Potamogeton.
Hedera Helix.	Cyperus (?).
Ulmus (?).	Phragmites (?).
Alnus glutinosa.	Grass nodes.
Quercus Robur, var. sessiliflora.	Equisetum.
Corylus Avellana.	

GREENOCK (ROXBURGH ST.).

From the Clyde Beds (Late Glacial or Neolithic) Mr. Thomas Scott obtained the following species:—

Potentilla Tormentilla (?).	Carex.
Taraxacum officinale.	*Anthoxanthum odoratum.
Thymus Serpyllum.	*Poa trivialis.
Atriplex patula.	

GRÜNENTHAL, HOLSTEIN.

Weber, *Neues Jahrb. Mineralogie, Geologie* . . . . 1891, Vol. II., pp. 62–85, 228–230; and 1893, Vol. I., pp. 94–96.)

* These I think are recent specimens; they are not in the same state of preservation as the others, and are therefore omitted in the summary. It is extremely difficult to prevent the adherence of light grass-seeds when removing lumps of clay.

The cuttings for the North Sea Canal showed silted-up channels with Pleistocene plants. One at Beldorf exposed a trough cut in the boulder-clay, filled with deposits yielding temperate plants, at the top of which occurred a layer with *Betula nana*, the whole being levelled up and hidden by recent peat. This intercalation of a temperate flora between the boulder-clay and an Arctic plant-bed agrees with the succession found at Hoxne in Suffolk. Another channel at Grossen-Bornholt is apparently of the same date. The plants occur in several different beds, full details being given in Dr. Weber's papers.

Ranunculus.
Nuphar luteum.
Nymphæa alba.
Brasenia purpurea.
Tilia platyphyllos.
Ilex aquifolium.
Acer.
Prunus Avium.
Hippurus vulgaris.
Myriophyllum spicatum.
Trapa natans.
Galium uliginosum.
Vaccinium Vitis-Idæa.
——— Myrtillus.
Andromeda Polifolia.
Fraxinus excelsior (?).
Menyanthes trifoliata.
Betula alba.
——— nana.
Alnus glutinosa.
Carpinus Betulus.
Corylus Avellana.
Quercus Robur.
Salix pentandra (?).
——— Caprea.
Ceratophyllum demersum.
Juniperus communis.
Picea excelsa.
Pinus sylvestris.
Stratiotes aloides.
Typha.
Potamogeton natans.
Najas flexilis.
Eriophorum.
Carex panicea.
Holcus.
Phragmites.

Hailes, near Edinburgh.

(J. Geikie, 'Great Ice Age,' 3rd edit., p. 99. 1894; Bennie, 'Arctic Plants in the old Lake Deposits of Scotland,' *Ann. Scottish Nat. Hist.*, 1894, pp. 46–52.)

Two plant-bearing deposits are found at this spot. The lower one rests immediately on the Boulder Clay and yields Arctic plants in the hollows between the boulders, the species sent to me by Mr. Bennie being:—

Thalictrum minus (?).	Stachys palustris.
Ranunculus aquatilis.	Ajuga reptans.
——— repens.	Polygonum aviculare.
Viola palustris.	Alnus glutinosa.
Lychnis diurna.	Salix herbacea.
Stellaria media.	—— polaris.
Oxalis Acetosella.	—— reticulata,
Hippuris vulgaris.	Empetrum nigrum.
Taraxacum officinale.	Eleocharis palustris.
Andromeda Polifolia.	Scirpus pauciflorus.
Menyanthes trifoliata.	Isoetes lacustris.

The newer deposit, resting immediately upon this Arctic plant-bed, contains Temperate species, among which will be observed various plants usually considered to be only present in this country as weeds of cultivation. The species collected by Mr. Bennie are as follows:—

Ranunculus aquatilis.	Hippuris vulgaris.
——— Flammula.	Æthusa Cynapium.
——— Lingua (?).	Sambucus nigra.
——— repens.	Valeriana officinalis.
Caltha palustris.	Chrysanthemum segetum.
Viola palustris.	Matricaria inodora.
Lychnis diurna.	Cnicus palustris.
——— Flos-cuculi.	Lapsana communis.
Stellaria media.	Menyanthes trifoliata.
——— uliginosa.	Pedicularis palustris.
Montia fontana.	Lycopus europæus.
Linum.	Stachys palustris.
Oxalis Acetosella.	Galeopsis Tetrahit.
Prunus spinosa.	Ajuga reptans.
——— Padus.	Atriplex patula.
Spiræa Ulmaria.	Polygonum Persicaria.
Rubus Idæus.	Rumex crispus.
——— fruticosus.	Mercurialis perennis.
Potentilla Tormentilla (?).	Betula alba.
——— Comarum.	Alnus glutinosa.
Cratægus Oxyacantha.	Corylus Avellana.

Quercus Robur.
Pinus sylvestris.
Potamogeton heterophyllus.
———— perfoliatus.
———— pusillus.
Eleocharis palustris.
Scirpus pauciflorus.
——— setaceus.
Scirpus lacustris.
Carex dioica.
——— echinata.
——— canescens.
——— flava.
Isoetes lacustris.
Chara.

HAPPISBURGH, NORFOLK.

(Reid, 'Geology of Cromer,' *Mem. Geol. Survey*, 1882; Reid, 'Pliocene Deposits of Britain,' *Mem. Geol. Survey*, 1890.)

Slabs of clay-ironstone full of leaves and twigs are thrown up by storms at this spot. They belong to the lower part of the Preglacial Cromer Forest-bed. This locality is the only one where determinable Preglacial *leaves* are found in any quantity.

Cornus sanguinea.
Ulmus.
Betula alba.
Alnus glutinosa.
Quercus Robur.
Fagus sylvatica.
Salix, 2 sp.
Pinus sylvestris.
Picea excelsa (cone).

HITCHIN, HERTFORDSHIRE.

(Reid, 'The Palæolithic Deposits at Hitchin and their Relation to the Glacial Epoch,' *Proc. Royal Soc.*, Vol. LXI., pp. 40-49. 1897.)

The plant-bearing deposits rest in a hollow eroded in the Glacial beds, underlie brick-earth with Palæolithic implements, and apparently correspond with the Interglacial deposits at Hoxne, though the overlying stratum with Arctic plants has not been discovered at Hitchin.

Ranunculus aquatilis.
———— sceleratus.
———— repens.
Montia fontana.
Prunus spinosa.
Poterium officinale.

Pyrus torminalis (?).
Hippuris vulgaris.
Myriophyllum.
Cornus sanguinea.
Sambucus nigra.
Eupatorium cannabinum.
Fraxinus excelsior.
Menyanthes trifoliata.
Lycopus europæus.
Ajuga reptans.
Alnus glutinosa.
Quercus Robur.
Ceratophyllum demersum.
Sparganium.
Potamogeton crispus.
——— 2 sp.
Najas marina.
Scirpus lacustris.
——— sp.
Carex.

Holmpton, Yorkshire.

(Reid, 'Geology of Holderness,' p. 85, *Mem. Geol. Survey*. 1885.)

A hollow in boulder-clay, filled with peaty loam, contains freshwater shells, and leaves of *Betula nana*, it is classed therefore as Late Glacial.

Honerdingen, Hanover.

(Weber, 'Ueber die fossile Flora von Honerdingen und das nordwestdeutsche Diluvium, *Abh. Naturw. Ver. Bremen*. Vol. XIII., pp. 413–468. 1896.)

The deposits are considered by Dr. Carl Weber to be of Interglacial date. He compares them with those of Fahrenkrug, Grünenthal, Klinge, and Lauenburg. The occurrence of *Platanus*, *Juglans*, and *Najas flexilis* is noticeable.

Thalictrum flavum.
Ranunculus Lingua.
Nuphar luteum.
Nymphæa alba.
Tilia platyphyllos.
—— parvifolia.
—— intermedia.
Ilex Aquifolium.
Rhamnus Frangula.
Acer platanoides.
Rubus Idæus.
Hippuris vulgaris.
Cornus sanguinea.
Fraxinus excelsior.
Menyanthes trifoliata.
Myrica Gale.
Betula pubescens.
—— alba (?).
Alnus glutinosa.
Carpinus Betulus.

Corylus Avellana.
Quercus sessiliflora.
Fagus sylvatica.
Salix.
Populus tremula.
Platanus (?).
Juglans regia (?).
Empetrum nigrum.
Ceratophyllum submersum.
——— demersum.
Typha.
Sparganium minimum.
——— simplex.
Potamogeton natans.
——— cf. polygonifolia.
Potamogeton rufescens.
——— cf. colorata.
——— graminea.
——— cf. prælonga.
——— perfoliata.
——— crispa.
Potamogeton compressa.
——— obtusifolia.
——— pusilla.
——— rutila.
——— cf. trichoides.
——— marina.
Najas major.
——— flexilis.
Scirpus lacustris.
Eriophorum vaginatum (?).
Carex acuta (?).
——— cf. acutiformis.
——— rostrata.
Phragmites communis.
Taxus baccata.
Juniperus communis.
Pinus sylvestris.
Abies pectinata.
Picea excelsa.
Equisetum palustre.
Polystichum cf. Thelypteris.

Hornsea, Yorkshire.

(Phillips, 'Geology of Yorkshire,' 3rd edit., Part I., pp. 75–79. 1875; Reid, 'Geology of Holderness,' *Mem. Geol. Survey*, pp. 79–83. 1885.)

Peaty mud fills a valley cut through the Glacial deposits. It contains Mammoth (?), Irish Elk, Lion, and *Bos primigenius* (?). The mollusca and plants are all recent British forms.

Prunus Padus.
Alnus glutinosa.
Quercus Robur.
Salix.
Pinus sylvestris.
Potamogeton.
Chara.

The stratigraphical position of this deposit and its resemblance to other 'Submerged forests' suggest a Neolithic or Late Glacial Age. The occurrence of the Mammoth, Lion, and *Bos primigenius*—if these were really obtained from it—point, on the other hand, to an earlier period.

Hoxne, Suffolk.

('Report of the Committee on the Relation of Palæolithic Man to the Glacial Epoch,' *Rep. Brit. Assoc.* for 1896, pp. 400–415, 1897.)

Ancient Alluvial deposits fill a channel newer than, and eroded through, the chalky boulder-clay, but independent of the existing valley system. Several plant-bearing zones are seen in direct superposition, A being the most recent :—

A, B.—Brick-earth and gravel with Palæolithic implements freshwater shells and bones of Elephant.

Alnus (?).
Potamogeton.
Chara.

C.—Black earth, with freshwater shells, leaves and seeds of Arctic plants.

Ranunculus aquatilis.
——— sceleratus.
——— repens [derivative (?)].
Caltha palustris.
Viola palustris.
Stellaria media.
Montia fontana.
Rhamnus Frangula [worn and derivative].
Rubus Idæus.
Poterium officinale.
Hippuris vulgaris.
Myriophyllum spicatum.
Œnanthe Phellandrium.
Sambucus nigra [derivative].
Eupatorium cannabinum.
Bidens tripartita.
Taraxacum officinale.
Menyanthes trifoliata.
Lycopus europæus.
Ajuga reptans.
Rumex maritimus.
——— crispus (?).
Urtica dioica (?) [one seed].
Betula nana.
Alnus glutinosa [perhaps derivative].
Carpinus Betulus [derivative].
Salix myrsinites.
—— herbacea.
—— polaris.
Ceratophyllum demersum.
Taxus baccata [derivative].
Sparganium ramosum.
Alisma Plantago.
Potamogeton rufescens.
——— crispus.

Potamogeton pusillus.
——— trichoides.
——— pectinatus.
Scirpus pauciflorus.
——— setaceus.
Scirpus lacustris.
Blysmus rufus.
Carex incurva (?).
Chara.

D.—Lignite with Temperate plants.

Ranunculus aquatilis.
——— sceleratus.
——— Lingua.
——— cf. repens.
Montia fontana.
Rhamnus Frangula.
Rubus Idæus.
Rosa canina.
Pyrus torminalis (?).
Œnanthe Phellandrium.
Sambucus nigra.
Eupatorium cannabinum.
Bidens tripartita.
——— var. with four equal awns.
Mentha aquatica.
Lycopus europæus.
Stachys (?).
Rumex maritimus.
——— crispus.
Rumex Acetosella (?).
Urtica dioica (?).
Alnus glutinosa.
Carpinus Betulus.
Corylus Avellana.
Ceratophyllum demersum.
Taxus baccata.
Sparganium ramosum.
Alisma Plantago.
Potamogeton pusillus.
——— trichoides.
Eleocharis acicularis.
Scirpus pauciflorus.
——— setaceus
——— lacustris
Blysmus rufus.
Eriophorum angustifolium.
Carex distans (?).
——— ampullacea (?).

E.—Clay with freshwater shells, fish-bones, and Temperate plants.

Ranunculus Lingua.
——— repens.
Rubus Idæus.
Hippuris vulgaris.
Rumex maritimus.
Alnus glutinosa.
Ceratophyllum demersum.
Sparganium ramosum.
Potamogeton trichoides.
Zannichellia palustris.
Scirpus lacustris.
Carex.

As beds D and E, containing a temperate flora, lie above the Glacial deposits and below loam with Arctic plants, they are classed as Interglacial. Bed C, containing Arctic plants, is newer than the boulder-clays of Suffolk, and is therefore called Late Glacial.

IRELAND (120 miles west of Dublin).

(Reid, 'The Origin of Megaceros-marl,' *Irish Naturalist*, May, 1895.)

A sample of the marl which yields the skeletons of the Irish elk was sent to me by Mr. W. Williams of Dublin. The exact locality was not stated. The deposit is a Chara-marl full of seeds of Pond-weeds, with a few other plants.

Ranunculus aquatilis.	Eleocharis palustris.
Myriophyllum spicatum.	Carex (?).
Littorella lacustris.	Scirpus (?).
Potamogeton crispus.	Chara (several species).
——— prælongus.	

The exact date of these marls is still uncertain, for the associated deposits have not yet been properly examined. Above similar Megaceros-marls at Ballaugh in the Isle of Man is found peat with *Salix herbacea*. No fossil Arctic plants have yet been found in Ireland, and the deposit is therefore provisionally classed with the Neolithic peat-mosses.

KELSEY HILL, YORKSHIRE.

(Reid, 'Geology of Holderness,' pp. 74, 75. *Mem. Geol. Survey*. 1885.)

Peaty clay caps an isolated sand-hill rising about 40 feet above the Humber marsh. The plants are:—

Ranunculus aquatilis.	Phragmites.
Potamogeton.	

The exact age of the deposit is doubtful; for, though provisionally classed as Neolithic, it may be Late Glacial.

KILMAURS, AYRSHIRE.

(Bennie, 'Note on the Contents of Two Bits of Clay from the Elephant Bed at Kilmaurs in 1817,' *Proc. R.*

Phys. Soc., Edinburgh, 1885, pp. 451–459; Craig, 'On the Post-Pliocene Beds of the Irvine Valley, Kilmaurs, and Dreghorn Districts,' *Trans. Geol. Soc. Glasgow*, 1887, pp. 213–226.)

The deposits occur beneath Boulder Clay, they yield remains of Mammoth and of the following species of plants :—

Ranunculus aquatilis.	*Potamogeton Zizii or heterophyllus.
Potentilla (?).	Zannichellia palustris.
Hippuris vulgaris.	Chara.
Myriophyllum spicatum.	Isoetes lacustris.
*Potamogeton rufescens (?).	

KIRK MICHAEL, ISLE OF MAN.

(Lamplugh, *Annual Rep. Geol. Survey* for 1895, p. 13.)

The plants occur in a peaty layer at a depth of 15 feet. They probably belong to the same period as the upper beds at Ballaugh, and the Arctic plant-beds near Edinburgh.

Ranunculus aquatilis.	Salix herbacea.
Viola palustris.	Potamogeton.
Potentilla Comarum.	Eleocharis palustris.
Hippuris vulgaris.	†Carex alpina.
Menyanthes trifoliata.	—— sp.

KIRMINGTON, NORTH LINCOLNSHIRE.

(Reid, 'Geology of Holderness,' pp. 58, 59, 69, 70, *Mem. Geol. Survey*. 1885.)

Estuarine warp, peat, and shingle occur at a height of about 80 feet above the sea. The peat is a mass of the common Reed, among which I could find no other plants. The warp contained :—

Scirpus fluitans. Phragmites communis.

* Determined by Mr. A. Bennett.

† Determined by Mr. C. B. Clarke.

Apparently a littoral deposit of the same date as the Interglacial marine gravels which occupy the lower grounds, and lie between two boulder-clays.

Klinge bei Cottbus, Prussia.

(Nehring, 'Ueber Wirbelthier-Reste von Klinge,' *Neues Jahrb. für Mineralogie*, 1895, pp. 183–208; Nehring, 'Ueber *Elephas*-Molaren, aus dem diluvialen Torflager von Klinge bei Cottbus,' *Gesellsch. naturf. Freunde*, 20th Oct., 1896.)

The deposit is probably of Interglacial date. The plants are associated with remains of Mammoth, Rhinoceros, Horse, Reindeer, and a species of *Megaceros* closely allied to the Irish Elk. The determination of the plants is mainly due to Dr. C. Weber.

Thalictrum flavum.
Nuphar luteum.
Nymphæa alba.
Brasenia ovulum.
Tilia platyphyllos (?).
Ilex aquifolium.
Acer campestre.
Comarum palustre.
Hippuris vulgaris.
Myriophyllum.
Galium palustre (?).
Vaccinium Oxycoccos.
Menyanthes trifoliata.
Betula verucosa.
—— odorata.
Alnus.
Carpinus Betulus.
Corylus Avellana.
Quercus.
Salix aurita.
—— cinerea.
—— repens.
—— Caprea (?).
Populus tremula.
Ceratophyllum submersum.
———— demersum.
Taxus baccata.
Pinus sylvestris.
Picea excelsa.
Stratiotes aloides.
Echinodorus ranunculoides (?).
Potamogeton natans.
Najas marina.
Scirpus lacustris.
——— pauciflorus (?).
Cladium Mariscus.
Carex, several sp.
Polysticum Thelypteris.

Lauenburg an der Elbe.

(Keilhack, 'Ueber ein interglaciales Torflager im Diluvium von Lauenburg an der Elbe,' *Jahrb. der k. preuss. geolog. Landesanstalt* für 1884. Berlin, 1885; Nathorst, 'Eine Probe aus dem Torflager bei Lauenburg an der Elbe,' *Naturwissensch. Wochenschrift*, 4th Nov., 1894.)

The exact relation of this peat to the Glacial deposits is not clear, and Professor Nathorst suggests that more than one plant-bed is represented. The occurrence of *Brasenia* suggests an Interglacial date.

Nymphæa alba.
Brasenia purpurea.
Corydalis fabacea.
Viola.
Arenaria trinervia.
Tilia platyphyllos.
Geranium columbinum.
Rhamnus Frangula.
Acer platanoides.
Trapa natans.
Cornus sanguinea.
Viburnum Opulus (?).
Lysimachia Nummularia (?).
Vaccinium Oxycoccos.
Fraxinus excelsior.
Menanythes trifoliata.
Lycopus europæus.
Ulmus.
Alnus glutinosa.
Carpinus Betulus.
Corylus Avellana.
Quercus Robur.
Salix aurita (?).
Salix repens.
Pinus sylvestris.
Picea vulgaris.
Larix europæa.
Iris Pseudacorus.
Sparganium.
Potamogeton.
Carex Pseudo-cyperus.

Mundesley, Norfolk.

(Reid, 'Geology of the Country around Cromer,' pp. 36, 37, 83, 84, 118, 119, and folding plate, *Mem. Geol. Survey*, 1882; also 'Pliocene Deposits of Britain,' pp. 166–169. *ibid.* 1890.)

At this locality three different plant-bearing deposits are represented. The oldest is Preglacial, and belongs to the Cromer Forest-bed, which is here divisible into an upper and a lower freshwater deposit, between which is a mass of estuarine gravel. The lower freshwater bed consists of laminated peat, full of fruits of *Trapa natans*, but containing little else. The middle or Estuarine division, contains bones of extinct mammals, much drift-wood, and cones of *Pinus sylvestris* and *Picea excelsa*. The upper freshwater bed is a thin seam of lacustrine clay, full of seeds of aquatic and marsh plants. The flora of this deposit is so uniform at most of the localities, that it is needless to repeat the list.

Above the Forest-bed lies an Early Glacial flood-loam or loess-like deposit containing bones of a *Spermophilus* and leaves and seeds of Arctic plants, the species being :—

Hippuris vulgaris.	*Salix polaris.*

Still higher, and cutting through the boulder clay, is seen an old river channel, subsequently silted-up with Alluvial mud containing remains of the water-tortoise (*Emys lutaria*), shells of *Hydrobia marginata*, and plants, the species observed being *Nuphar luteum*, *Ceratophyllum demersum*, and *Salix*. This deposit is probably equivalent to beds D and E at Hoxne, and is here provisionally classed as Interglacial.

Northampton.

An Alluvial deposit of uncertain age yields the following plants, sent to me by Mr. H. N. Dixon:—

Nuphar luteum.	Polygonum.
Stellaria media.	Mercurialis perennis.
Prunus spinosa.	Alnus.
——— Padus.	Corylus Avellana.
Sambucus nigra.	Quercus Robur.

Ostend, Norfolk.

(Reid, 'Geology of the Country around Cromer,' pp. 41–43, 62–65, *Mem. Geol. Survey.* 1882; 'Pliocene Deposits of Britain,' pp. 171, 195, *ibid.* 1890.)

Two distinct plant-bearing deposits are here represented. The older belongs to the Preglacial Cromer Forest-bed, and contains cones of *Picea excelsa* and fruits of *Trapa natans.* The newer is Early Glacial, contains

Arctic plants, and corresponds to the similar deposit at Mundesley, *Salix polaris* being abundant. The older deposit yields :—

Thalictrum flavum.	Alnus glutinosa.
Ranunculus aquatilis.	Corylus Avellana.
Hippuris vulgaris.	Quercus Robur.
Trapa natans.	Taxus baccata.
Cornus sanguinea.	Pinus sylvestris.
Menyanthes trifoliata.	Picea excelsa.
Rumex maritimus.	

The Early Glacial bed contains :—

Hippuris vulgaris.	Potamogeton.
Betula nana.	Carex.
Salix polaris.	

Overstrand, Norfolk.

(Reid, 'Geology of the Country around Cromer,' and 'Pliocene Deposits of Britain,' *Mem. Geol. Survey.* 1882 and 1890.)

At this locality the Preglacial Cromer Forest-bed is full of drift-wood and fir-cones, and its upper, freshwater division contains seeds of *Cratægus Oxyacantha*—a plant unknown elsewhere in Preglacial deposits. The other plants are all common to several localities and the list need not be repeated.

Overtoun, near Beith, Ayrshiré.

(Craig, *Trans. Geol. Soc. Glasgow*, Vol. IV., p. 145.)

Hazel nuts are here said to occur between two masses of till.

Oxford.

(A. M Bell, 'On the Pleistocene Gravel at Wolvercote, near Oxford,' *Rep. Brit. Assoc.* for 1894, p. 663.)

A Pleistocene alluvial deposit at Wolvercote, near

Oxford, shown to me by the late Professor A. H. Green, yields the following species of plants :—

Ranunculus aquatilis.
——— sceleratus.
——— repens.
Potentilla Tormentilla.
Viola
Hippuris vulgaris.
Heracleum Sphondylium.
Potamogeton.
Eleocharis palustris.
Scirpus lacustris.
Carex rostrata.

This plant-bed lies above a deposit with bones of Bison and Palæolithic implements, and is of uncertain age.

PAKEFIELD, SUFFOLK.

(Reid, 'Pliocene Deposits of Britain,' pp. 177–179. *Mem. Geol. Survey.* 1890.)

A silted-up channel belonging to the Preglacial Cromer Forest-bed occurs at about two hundred yards south of the Lighthouse Gap. It has yielded about fifty species of flowering plants, among which are a few dry-soil species unknown elsewhere in deposits of this date. The plants are :—

Thalictrum flavum.
Ranunculus aquatilis.
——— sceleratus.
——— repens.
Nuphar luteum.
Viola palustris.
Hypericum quadrangulum.
Acer campestre.
Prunus spinosa.
Spiræa Ulmaria.
Rubus fruticosus.
Potentilla.
Pyrus Aria.
Trapa natans.
Myriophyllum spicatum.
Hydrocotyle vulgaris.
Œnanthe Lachenalii.
——— Phellandrium.
Heracleum Sphondylium.
Cornus sanguinea.
Bidens tripartita.
Lapsana communis.
Picris hieracioides.
Mentha aquatica.
Lycopus europæus.
Atriplex patula.
Polygonum Persicaria.
Rumex maritimus.
——— sp.
Euphorbia amygdaloides.
Betula alba.
Alnus glutinosa.
Carpinus Betulus.
Corylus Avellana.
Quercus Robur.
Ceratophyllum demersum.

Taxus baccata.
Sparganium ramosum.
Alisma Plantago.
Potamogeton lucens.
——— trichoides.
Zannichellia palustris.
——— pedunculata.
Najas marina.
Najas minor.
Eleocharis palustris (?).
Scirpus pauciflorus.
——— lacustris.
Carex remota.
——— paludosa (?).
——— riparia.
Phragmites communis.

PARKSTONE, DORSET.

(Reid, 'On Charred Pine-wood from Dorset Peat Mosses,' *Proc. Dorset Nat. Hist. Field Club*, Vol. XVI., p. 14. 1895.)

The bottom layers of a peat-moss here contain trunks and cones of *Pinus sylvestris*.

REDHALL, NEAR EDINBURGH.

(Henderson, 'On some Sections of Boulder Clay, Peat, and Stratified Beds exposed in a Quarry recently opened at Redhall, Slateford, near Edinburgh.' *Trans. Geol. Soc., Edinburgh*, Vol. II., p. 391. 1874; Geikie, 'Great Ice Age,' 3rd Edit., pp. 100, 101. 1894; Bennie and Scott, 'The Ancient Lakes of Edinburgh,' *Proc. R. Phys. Soc., Edinburgh*, Vol. X., pp. 126–154. 1889.)

The Deposit at Redhall, like that of Cowden Glen, has been generally accepted as of Interglacial age. The many weeds of cultivation, capsules of Flax, and pieces of charcoal, that it contains can scarcely belong to any earlier period than the Neolithic. The flora closely corresponds with that of the upper bed at Hailes.

Ranunculus aquatilis.
——— Flammula.
——— Lingua.
——— repens.
Caltha palustris.
Fumaria officinalis.
Viola palustris.
Lychnis diurna.
Lychnis Flos-cuculi.
Stellaria media.
——— uliginosa.
Spergula arvensis.
Montia fontana.
Hypericum quadrangulum.
——— elodes.
Linum.

Oxalis Acetosella.
Prunus.
Spiræa Ulmaria.
Rubus Idæus.
——— fruticosus.
Potentilla Tormentilla.
———— Comarum.
Alchemilla arvensis.
Poterium officinale.
Rosa canina (?).
Cratægus Oxyacantha.
Sambucus nigra.
Valeriana officinalis.
Eupatorium canabinum.
Bidens cernua.
Crysanthemum segetum.
Matricaria inodora.
Tussilago Farfara.
Senecio sylvaticus.
Cnicus lanceolatus.
——— palustris.
Centaurea Cyanus.
Lapsana communis.
Crepis virens.
Leontodon autumnalis.
Taraxacum officinale.
Sonchus arvensis.
Menyanthes trifoliata.
Pedicularis palustris.
Lycopus europæus.
Prunella vulgaris.
Stachys palustris.
Galeopsis Tetrahit.
Ajuga reptans.
Littorella lacustris.
Atriplex patula.
Polygonum aviculare.
———— Persicaria.
Rumex obtusifolius.
——— crispus.
Euphorbia Helioscopia.
Alnus glutinosa.
Quercus Robur.
Pinus.
Juncus glaucus (?).
Sparganium ramosum.
Alisma Plantago.
Potamogeton perfoliatus.
———— pusillus.
Eleocharis palustris.
Scirpus pauciflorus.
——— setaceus.
Carex dioica.
——— echinata.
——— canescens.
——— panicea.
——— flava.
* Holcus lanatus.
Agrostis.
* Poa trivialis.
* Dactylus glomerata.

SAND LE MEER, YORKSHIRE.

(Reid, 'Geology of Holderness,' p. 84, *Mem. Geol. Survey.* 1885.)

In a 'submerged forest' of the ordinary type, opposite the mouth of a small valley, the plants observed were:—

Prunus Padus.
Alnus glutinosa.
Corylus Avellana.
Quercus Robur.
Salix.
Juncus.
Potamogeton.
Carex.

* Probably recent specimens.

SELSEY, SUSSEX.

(Reid, 'The Pleistocene Deposits of the Sussex Coast, and their Equivalents in Other Districts,' *Quart. Journ. Geol. Soc.*, Vol. XLVIII., pp. 344–366. 1892.)

Carbonaceous river-mud here overlies Glacial erratics and underlies the Palæolithic deposits. The river-mud is apparently of Interglacial date, and corresponds closely in position and fossil contents with the strata found at West Wittering and Stone. The plant-remains consist of drifted seeds, *Acer monspessulanum* giving a southern aspect to the flora :—

Acer monspessulanum.	Atriplex patula.
Prunus Avium.	Polygonum aviculare.
——— Padus.	Quercus Robur.
Rubus fruticosus.	Zannichellia palustris.
Rosa.	Scirpus pauciflorus (?).
Ajuga reptans.	Carex distans (?).

SHACKLEWELL, MIDDLESEX.

(Prestwich, 'On a Fossiliferous Deposit in the Gravel at West Hackney,' *Quart. Journ. Geol. Soc.*, Vol. XI., p. 107. 1885; Reid, 'Pleistocene Plants from Casewick, Shacklewell and Grays.' *Ibid.* Vol LIII., pp. 463, 464. 1897.)

Peaty clay is found beneath 8 or 10 feet of gravel. Though none but British species of Mollusca or plants have yet been discovered, the geology suggests a considerable antiquity. The plants are Temperate species :—

Ranunculus repens.	Lycopus europæus.
Rubus Idæus.	Alnus glutinosa.
Rosa.	Quercus Robur.
Eupatorium cannabinum.	

SIDESTRAND, NORFOLK.

(Reid, 'Geology of the Country around Cromer.' 1882; and 'Pliocene Deposits of Britain,' *Mem. Geol. Survey.* 1890.)

The upper part of Preglacial Cromer Forest-bed is here a bed of blue lacustrine clay, full of freshwater shells and seeds of aquatic and marsh plants. Dry-soil species and forest trees are absent. Among the plants are *Trapa natans* and *Stratiotes aloides*.

Silchester Roman Station, Hampshire.

(Hope and Fox, 'Excavations on the site of the Roman City at Silchester, Hants, in 1890–1897,' *Archæologia*, Vols. L.–LVII. 1891–1898.)

Some material sent to me in April of the present year (1899) by Mr. A. H. Lyell, from one of the excavations made to explore this station, contained a number of seeds which belong to the date of the Roman occupation. They do not include cultivated plants of any sort, with the doubtful exception of a single capsule of flax; but among them are several weeds of cultivation, the seeds of which are small and starved, as though growing on exhausted land that for some years had been out of cultivation or occupation.

Thalictrum flavum.
Ranunculus Flammula.
———— Lingua.
———— repens.
———— Sardous.
Caltha palustris.
Papaver Argemone.
Thlaspi arvense.
Lychnis Flos-cuculi.
Stellaria media.
———— graminea.
Hypericum perforatum.
Linum usitatissimum (?).
Spiræa Ulmaria.
Rubus fruticosus.
Potentilla Tormentilla.
Alchemilla arvensis.
Conopodium denudatum.
Æthus aCynapium.
Sambucus nigra.
Galium.
Chrysanthemum Leucanthemum.
Mentha aquatica.
Prunella vulgaris.
Stachys arvensis
Galeopsis Tetrahit.
Atriplex.
Polygonum Aviculare.
Rumex conglomeratus.
Eleocharis acicularis.
———— palustris.
Carex.

SOUTHAMPTON DOCKS.

(Shore and Elwes, 'The New Dock Excavation at Southampton,' *Proc. Hants Field Club* for 1889, pp. 43-56.)

A bed of peat and shell-marl beneath the sea-level yields Neolithic implements, and is said to contain Oak, Beech, Hazel, Birch, and Pine, besides decomposed remains of *Scirpus lacustris*, *Carex*, *Myrica Gale*, heaths, *Pteris aquilina*. A small sample given me by Mr. Whitaker contained seeds of:—

Rubus Idæus.
Sambucus nigra.
Corylus Avellana.
Scirpus maritimus (?).

SOUTHELMHAM, SUFFOLK.

(Candler, 'Observations on some Undescribed Lacustrine Deposits at Saint Cross, South Elmham, in Suffolk,' *Quart. Journ. Geol. Soc.*, Vol. XLV., pp. 504–510. 1889.)

The plant-bearing stratum yields bones of Elephant, and probably agrees with the Interglacial beds D and E at Hoxne. It overlies the Boulder Clay, but is not overlain by any newer deposit.

Thalictrum flavum.
Ranunculus aquatilis.
——— sceleratus.
——— Flammula.
Cratægus Oxyacantha.
Hippuris vulgaris.
Myriophyllum spicatum.
Hydrocotyle vulgaris.
Œnanthe Phellandrium.
Cnicus palustris (?).
Taraxacum officinale.
Menyanthes trifoliata.
Lycopus europæus.
Rumex maritimus.
Alnus glutinosa.
Ceratophyllum demersum.
Stratiotes aloides.
Alisma Plantago.
Potamogeton heterophyllus.
——— perfoliatus.
——— crispus.
——— obtusifolius.
——— trichoides.
Zannichellia palustris.
Scirpus pauciflorus.
——— cæspitosus.
——— fluitans.
——— lacustris.
Carex riparia.
——— rostrata.

Stoke Newington, London.

(W. G. Smith, 'Man the Primeval Savage,' pp. 288, 289. 8vo, London, 1894.)

The Palæolithic deposits here have yielded various plants; but the specimens deposited in the British Museum by Mr. Worthington Smith are not at present available. He mentions:—

Clematis Vitalba. (Leaves.)
Vitis vinifera. (Wood; perhaps a recent specimen.)
Rubus (?). (Fragments of stems, with thorns.)
Ulmus.
Betula. (Bark and wood.)
Alnus glutinosa. (Leaves and catkins.)
Corylus.
Taxus.
Pinus.
Rushes. } Impressions.
Sedges. }
Grass. }
Aspidium Filex-mas. (Impressions of pinnæ.)
Osmunda regalis. (Fronds and rhizomes.)

Stone, Hampshire.

(Reid, 'A fossiliferous Pleistocene Deposit at Stone, on the Hampshire Coast,' *Quart. Journ. Geol. Soc.*, Vol. XLIX., pp. 325–328. 1893.)

Carbonaceous river-mud here underlies the Palæolithic gravels. It is evidently equivalent to the Interglacial deposits of West Wittering and Selsey, and contains remains of Elephant and of the following plants:—

Ranunculus sceleratus.
——— repens.
Arenaria peploides.
Acer monspessulanum.
Rubus fruticosus.
Potentilla.
Rosa.
Myriophyllum.
Caucalis nodosa.
Valeriana officinale.
Mentha aquatica.
Lycopus europæus.
Atriplex patula.
Polygonum aviculare.

Rumex.	Zannichellia palustris.
Urtica.	Eliocharis acicularis.
Quercus Robur.	Scirpus lacustris.
Sparganium.	Carex riparia (?).
Alisma Plantago.	——— rostrata.
Potamogeton heterophyllus.	——— muricata.
——————— trichoides.	Phragmites.
Ruppia maritima.	

SWEDEN.

(Gunnar Andersson, 'Svenska Växtvarldens Historia,' 8vo, Stockholm, 1896; and 'Geschichte der Vegetation Schwedens,' *Englers Bot. Jahrb.*, Bd. XXII., pp. 434–550. 1896.)

The extensive literature relating to Swedish Quaternary fossil plants has been brought together by Dr. Gunnar Andersson, who refers the deposits to the following five zones, all corresponding, apparently, with our late Glacial and Neolithic, no plant-bearing strata of Interglacial or of Preglacial date being yet known in Sweden.

5 Spruce Zone.
4 Oak Zone.
3 Pine Zone.
2 Birch Zone.
1 Dryas Zone.

No. 1 corresponds in all probability with the Arctic plant-beds of Hailes, Corstorphine, and Gayfield.

As Dr. Gunnar Andersson records no fewer than 133 species of flowering plants, the table is too long here to be reproduced; but the range in Sweden, where it supplements the British records, is mentioned in the next Chapter under the heading of each species.

TILBURY, ESSEX.

(Spurrell, 'On the Estuary of the Thames and its Alluvium,' *Proc. Geol. Assoc.*, Vol. XI., pp. 210–230. 1889.)

The 'Submerged Forests' met with during the excavation of Tilbury Docks apparently belong to the same period as those seen at Crossness and at the Albert Dock; they underlie a layer with Roman remains, but the small list of plants includes nothing characteristic of any particular date :—

Sambucus nigra.	Quercus Robur sessiliflora.
Betula alba.	Sparganium ramosum.
Alnus glutinosa.	Carex.
Corylus Avellana.	Phragmites communis.

TRIMINGHAM, NORFOLK.

(Reid, 'Geology of the Country around Cromer,' 1882; and 'Pliocene Deposits of Britain,' *Mem. Geol. Survey.* 1890.)

Good sections of the Preglacial Cromer Forest-bed can be seen at the foot of the cliffs and on the foreshore at Trimingham. The Early Glacial freshwater deposits may also be represented there; but I have not yet been able to find any of the characteristic Arctic plants in them.

TWICKENHAM, MIDDLESEX.

(Leeson & Laffan, 'On the Geology of the Pleistocene Deposits in the Valley of the Thames at Twickenham. . . .' *Quart. Journ. Geol. Soc.*, Vol. L., pp. 453–462. 1894.)

A small silted-up channel is here found beneath the Thames gravel. It is of interest as yielding mammals which perhaps point to a transition between the Palæolithic and Neolithic periods. The species are the Bison, Reindeer, Horse, and *Bos longifrons.* The plants include *Galeopsis Tetrahit*, usually a weed of cultivation; but there are no definite signs of cultivated plants or domesticated animals. From the presence of Reindeer the deposit is classed as Late Glacial.

Stellaria media.	Potamogeton rufescens.
Montia fontana.	Zannichellia palustris.
Heracleum Sphondylium.	Eleocharis palustris.
Galeopsis Tetrahit.	Scirpus lacustris.
Atriplex.	Carex panicea.
Polygonum Persicaria.	Phragmites.
Rumex crispus.	

West Runton, Norfolk.

(Reid, 'Geology of the Country around Cromer,' 1882; and 'Pliocene Deposits of Britain,' *Mem. Geol. Survey.* 1890.)

The upper part of the Preglacial Cromer Forest-bed is here represented by a mass of peat filling a shallow channel. It is full of remains of animals and plants, but the latter are not usually well preserved, and have not yet been properly collected. They seem to include a somewhat larger proportion of dry-soil species than is usually found in deposits of this age.

West Wittering, Sussex.

(Reid, 'The Pleistocene Deposits of the Sussex Coast. . . .' *Quart. Journ. Geol. Soc.*, Vol. XLVIII., pp. 344–361. 1892.)

The plant-bearing strata yield a Temperate flora, but contain at their base far-travelled erratic blocks, derived from an earlier glacial deposit, and are overlaid by brick-earth of Late Glacial date. The plant-bed corresponds with those at Selsey and Stone, and contains remains of Elephant, Rhinoceros, with some freshwater shells no longer living in Britain. Local conditions being exceptionally favourable, the flora is unusually varied, freshwater, estuarine, sea-coast, marsh, dry-soil, woodland, and limestone species all being represented by their seeds. Leaves, except badly preserved fragments, are not found. The 94 species in the subjoined list were obtained by Mrs. Reid and myself by washing about two hundredweight of the loamy sand. Only two of those determined are now extinct in Britain, though among the undetermined seeds are several well-marked forms, which do not belong to any living British plants, but cannot yet be identified. *Najas minor* and *N. graminea* are both southern forms. *Acer monspessulanum*, so common at Selsey on the east, and at Stone on the west, has not yet been found at West Wittering. The exotic species probably number nearly 10 per cent.; but in the absence of good collections of ripe seeds their determination is very difficult.

Thalictrum flavum.
Ranunculus aquatilis.
——— hederaceus.
——— sceleratus.
——— Lingua.
——— repens.
——— bulbosus.
——— Sardous.
——— parviflorus.
Caltha palustris.
Nuphar luteum.
Nymphæa alba.
Chelidonium majus.
Silene maritima.
Lychnis diurna.
——— Flos-cuculi.
Stellaria aquatica.
——— media.
——— Holostea.
Montia fontana.
Hypericum perforatum.
——— quadrangulum.
Ilex aquifolium.
Rhamnus Frangula.
Prunus spinosa.
——— Avium.
Spiræa Ulmaria.
Rubus fruticosus.
Potentilla Tormentilla.
Alchemilla arvensis.
Poterium officinale.
Rosa.
Hippuris vulgaris.
Myriophyllum spicatum.
Hydrocotyle vulgaris.
Apium graveolens.
——— nodiflorum.
Chærophyllum temulum.
Anthriscus sylvestris.
Œnanthe fistulosa.
——— Phellandrium.
Angelica sylvestris.
Cornus Sanguinea.
Sambucus nigra.
Viburnum Opulus.
——— Lantana.
Valerianella olitoria.
Scabiosa succisa.

Eupatorium cannabinium.
Aster Tripolium.
Senecio aquaticus.
Cnicus lanceolatus.
——— palustris.
Lapsana communis.
Hieracium Pilosella.
Taraxacum (?).
Glaux maritima.
Menyanthes trifoliata.
Solanum Dulcamera.
Verbascum Thaspus.
Mentha aquatica.
Lycopus europæus.
Stachys palustris.
Ajuga reptans.
Atriplex patula.
Polygonum Persicaria.
Rumex conglomeratus.
——— obtusifolius.
——— crispus.
Mercurialis perennis.
Betula alba.
Corylus Avellana.
Quercus Robur.
Salix cinerea.
Ceratophyllum demersum.
Sparganium ramosum.
Alisma Plantago.
Sagittaria sagittifolia.
Potamogeton natans.
———— heterophyllus.
———— lucens (?).
———— densus.
———— trichoides.
Ruppia maritima.
Zannichellia pedunculata.
Najas minor.
—— graminea.
Eleocharis acicularis.
——— palustris.
Scirpus lacustris.
Carex muricata.
—— distans.
—— rostrata.
—— riparia.

WEYMOUTH.

(Gepp, 'Fossil Plant-remains in Peat,' *Journ. Botany*, Vol. XXXIII., pp. 180–182. 1895.)

Cakes of compressed peat thrown up near Weymouth have yielded a few plants, among which is the white water-lily. The peat is apparently derived from the seaward edge of Lodmoor, which lies to the north-east of Weymouth. Its age is not earlier than Neolithic, and at present it is impossible to say whether it may not be entirely Post-Roman.

Nymphæa alba.
Prunus Padus.
Myriophyllum spicatum.
Sambucus nigra.
Alnus glutinosa.
Ceratophyllum demersum.
Sparganium ramosum (?).
Potamogeton natans.
———— lucens.
———— perfoliatus.
Scirpus maritimus (?).
Carex.
Phragmites communis.
Osmunda regalis.

CHAPTER VI.

Former Distribution of British Plants.

I HAVE set down in this chapter what is known of the past history of our British Plants; but the species about which we have as yet been able to learn anything amount only to about one-sixth of the flora, though constant additions are being made to the number. Under these circumstances, and in face of the imperfection of the record in Pliocene times, I doubt whether it would be of much use to attempt any minute analysis of the list; all that can be done with advantage, is to draw attention to the leading changes in geographical distribution that have already been proved.

Variations caused by climatic changes were spoken of in Chapter IV. In the course of time, however, there have been other changes in distribution; for it is obvious that a flora driven south by a cold wave, on its return when the climate has again become genial is not likely to consist of exactly the same species. The chances of dispersal cannot be twice alike. When the mammals and birds change, the relative power of spreading possessed by the different plants must change also; when England is connected with the Continent, and the Rhine flows to Norfolk, heavy seeds must have easier travelling than when Britain becomes an island. Other differences in geographical distribution seem to be the result of accident—one plant has accidentally been introduced and has had time to spread, a later comer needing the same station finds the ground pre-occupied. All the proved cases will now be brought together; but, as this chapter is merely a record of facts, it does not seem advisable at present to deal with the converse side of the question, that is to say with the noticeable absence of many of our most common living species. This deficiency, also, may be apparent only, not real, and till we have a fuller knowledge of the fossil plants it is undesirable to throw out suggestions which to-morrow's work may show to be founded on nothing more than the incompleteness of our search.

The exotic plants which have as yet been recorded as British fossils are only six; but I may repeat, in a more general sense, the remarks already made, with regard to the plants of one locality, and say that in reality the proportion of exotic species must be considerably greater. These are the plants for the determination of which it is most difficult to obtain the necessary material. Botanists seldom collect plants in fruit, and, if they do, the ordinary method of preserving specimens is not suitable, as most of the seeds that are ripe, or nearly ripe, fall out and are lost in drying. My own collection of recent seeds and fruits includes only a small proportion of exotic forms; but I have examined various fossil seeds which certainly do not belong to any living British plant, and are quite determinable, if only sufficiently complete continental collections were available.

Papaver somniferum has only been found at Cowden Glen, and in face of the great uncertainty as to the age of the peaty deposit at that place I do not feel prepared to accept it as a true fossil, though the opium-poppy was apparently grown in Switzerland in Neolithic times.

Acer monspessulanum occurs in Interglacial deposits at Selsey, in Sussex, and at Stone, in Hampshire. It now flourishes throughout the Mediterranean region, and extends into Central Europe. This maple grows well in gardens in the South of England and seeds freely; though I have not heard of any case in which it has spread from self-sown seedlings. Mr. A. R. Wallace has undertaken some experiments in Dorset with a view to ascertain whether this plant can establish itself under natural conditions.

Trapa natans is found in the Cromer Forest-bed, but does not seem to have re-entered this country after it had been driven out by the cold. It is an aquatic plant still living as near as the South of Sweden, and has large edible fruits known as water-chestnuts. Its absence in Britain seems to be unconnected with changed climatic conditions.

Salix polaris occurs abundantly in Glacial deposits, both Early and Late; but it has now completely disappeared from Britain. It grows within the Arctic Regions, and on the highest mountains of Scandinavia.

Picea excelsa was common in the East of England in Preglacial times. It is apparently another large-seeded plant that has been unable to re-establish itself here, now that Britain is separated from the Continent. There is nothing in the modern distribution of the spruce-fir to suggest that it is unsuited for our present climate, though this tree does not tend to spread from seedlings as do *Pinus sylvestris* and *Pinus maritima*.

Najas graminea has only been found in the Interglacial deposit at West Wittering in Sussex. Its recent distribution is throughout the Tropics of the Old World, and also in the Mediterranean Region. In Britain it has been introduced at one spot, where it grows in a canal which receives waste hot water from a mill.

Najas minor occurs in Preglacial deposits, and at West Wittering. It also belongs to warmer climates, ranging throughout Europe except in the north and in Britain. It is living in the Rhine.

A certain number of our fossil-plants, though still living in Britain, formerly had a range markedly different. The majority of these species are northern forms, which formerly occupied our lowlands, but on the passing away of the cold of the Glacial Epoch could only live on our mountain tops. They are *Dryas octopetala*, *Arctostaphylos Uva-ursi*, *Andromeda Polifolia*, *Loiseleuria procumbens*, *Oxyria digyna*, *Betula nana*, *Salix Myrsinites*, *Salix herbacea*, *Salix reticulata*, *Carex alpina*. The Temperate species of which the ancient distribution within Britain was markedly different from that now existing were only three or four.

Quercus Robur appears at one time to have grown at higher elevation; for remains of well-grown oaks occur occasionally in peat mosses above the limit of any but stunted trees.

Pinus sylvestris seems to have been abundant throughout Britain during part of the Neolithic Period, for its cones are abundant at the base of peat-mosses and in 'submerged forests.' It afterwards disappeared from the South of England and only recently has been re-introduced.

Potamogeton trichoides occurred in Sussex and Hampshire in Interglacial times; it is now confined in Britain to Norfolk, Suffolk, and the West of Ireland.

Najas marina, now confined to a single locality in Norfolk, was formerly widely distributed. It has now been found fossil in Norfolk, Suffolk, Hertfordshire, and Glamorgan.

CLEMATIS VITALBA, L.

Interglacial (?):—

Stoke Newington, London.

Mr. Worthington Smith has recorded leaves of this plant from a Palæolithic deposit at Stoke Newington.

THALICTRUM MINUS, L.

Late Glacial:—

Hailes, near Edinburgh, associated with *Salix polaris*

Early Glacial:—

Beeston, Norfolk (base of Arctic Freshwater bed).

Two small sharp-ribbed fruits have been found at Hailes and are doubtfully referred to this species. Two small fruits from Beeston, the one oval the other elongated, sharp-ribbed and obscurely stalked, may also be referred to *T. minus*. In each case the fruits are considerably smaller than my recent specimens.

THALICTRUM FLAVUM, L.

Roman Period:—

Silchester, Hampshire.

Interglacial:—

West Wittering, Sussex; Southelmham, Suffolk.

Preglacial (Cromer Forest-bed):—

Beeston, Sidestrand, Mundesley, Ostend (Norfolk); Corton, Pakefield (Suffolk).

Also at Honerdingen in Hanover (Carl Weber); Klinge bei Cottbus, Prussia, where it is associated with *Brasenia*, *Najas marina*, &c.; and in the Pine Zone (Neolithic?) in Sweden (Gunnar Andersson).

RANUNCULUS AQUATILIS, L.

Neolithic:—

Kelsey Hill, Yorkshire; lacustrine deposits of the Scottish Lowlands at Redhall, Hailes, Broughton, Elie, and Cowden Glen; Megaceros-marl of Ireland.

Late Glacial:—

Hoxne, Suffolk (Bed C); Kirk Michael, Isle of Man; Ballaugh, Isle of Man; Hailes, near Edinburgh (lower bed); Corstorphine, near Edinburgh; Dronachy, Fife; Gayfield, near Edinburgh.

Interglacial:—

West Wittering, Sussex; Endsleigh Street, London; Hitchin, Hertfordshire; Hoxne, Suffolk (bed D); South-elmham, Suffolk; Allenton, Derby; Airdrie, Lanark; Kilmaurs, Ayrshire.

Early Glacial:—

Beeston, Norfolk (at base of the Glacial deposits).

Preglacial (Cromer Forest-bed):—

Beeston, Cromer, Sidestrand, Trimingham, Mundesley, Ostend (Norfolk); Pakefield, Suffolk.

Several varieties occur fossil; but the characters of the fruit do not seem to be sufficiently constant in the recent state to allow of any determination of sub-species from fruit alone.

Ranunculus hederaceus, L.

Interglacial:—

West Wittering, Sussex.

Probably common elsewhere, but included among the forms of *R. aquatilis*.

Ranunculus sceleratus, L.

Neolithic:—

Crossness, Essex (lower peat).

Late Glacial:—

Hoxne, Suffolk (bed C).

Interglacial :—

Stone, Hampshire; West Wittering, Sussex; Endsleigh Street, London; Hitchin, Hertfordshire; Hoxne, Suffolk (Bed D); Southelmham, Suffolk; Allenton, near Derby.

Preglacial (Cromer Forest-bed) :—

Pakefield, Suffolk.

RANUNCULUS FLAMMULA, L.

Roman Period :—

Silchester, Hampshire.

Neolithic :—

Ballaugh, Isle of Man (bed A); lacustrine deposits of the Scottish Lowlands, Redhall, Hailes, Broughton, Cowden Glen, Elie; Fillyside, near Edinburgh (in raised beach).

Late Glacial :—

Ballaugh, Isle of Man (bed D).

Interglacial :—

Southelmham, Suffolk; Allenton, near Derby.

RANUNCULUS LINGUA, L.

Roman Period :—

Silchester, Hampshire.

Neolithic :—

Broughton, near Edinburgh; Redhall, near Edinburgh; Hailes, near Edinburgh (one doubtful specimen).

Interglacial :—

West Wittering, Sussex; Hoxne, Suffolk (beds D and E).

RANUNCULUS ACRIS, L.

I can find no trace of this species in deposits as old as the Roman occupation.

RANUNCULUS REPENS, L.

Roman Period :—

Silchester, Hampshire.

Neolithic :—

Crossness, Essex (upper and lower peats); Fillyside, near Edinburgh (raised beach); Lacustrine deposits of the Scottish Lowlands, Redhall, Hailes, Broughton, Elie.

Late Glacial :—

Hoxne, Suffolk (bed C); Ballaugh, Isle of Man; Close y Garey, Isle of Man; Hailes, near Edinburgh (lower bed); Gayfield, near Edinburgh; Corstorphine, near Edinburgh; Garvel Park (Clyde Beds).

Interglacial :—

Stone, Hampshire; West Wittering, Sussex; Grays, Essex; Endsleigh Street, London; Shacklewell, London; Hitchin, Hertfordshire; Hoxne (beds D and E); Allenton, Derby.

Preglacial (Cromer Forest-bed)—

Beeston, West Runton, Sidestrand, Mundesley (Norfolk); Pakefield (Suffolk).

RANUNCULUS BULBOSUS, L.

Interglacial :—

West Wittering, Sussex; Allenton, near Derby (a doubtful carpel).

RANUNCULUS SARDOUS, CRANTZ.

Roman Period :—

Silchester, Hampshire.

Interglacial :—

West Wittering, Sussex; Allenton, near Derby.

RANUNCULUS PARVIFLORUS, L.

Interglacial :—

West Wittering, Sussex.

RANUNCULUS FICARIA, L.

This has not yet been found in a fossil state; the carpels, however, are softer than in most of the other species of *Ranunculus*, and are less likely to be preserved.

CALTHA PALUSTRIS, L.

Roman Period :—

Silchester, Hampshire.

Neolithic :—

Redhall, near Edinburgh; Hailes, near Edinburgh.

Late Glacial :—

Hoxne, Suffolk (bed C).

Interglacial :—

West Wittering, Sussex.

Preglacial (Cromer Forest-bed) :—

Mundesley, Norfolk.

NUPHAR LUTEUM, L.

Neolithic and Postglacial :—

Hampton Waterworks, Middlesex; Casewick, Lincolnshire; Northampton (old river bed).

Interglacial :—

West Wittering, Sussex; Mundesley, Norfolk (old river deposit).

Preglacial (Cromer Forest-bed) :—

Beeston, West Runton, Cromer, Overstrand, Sidestrand, Mundesley (Norfolk); Corton, Pakefield (Suffolk).

Nymphæa alba, L.

Recent Alluvium (?):—

Happisburgh, Norfolk; Weymouth.

Interglacial:—

West Wittering. Also at Grünenthal and Fahrenkrug, in Holstein, and Klinge bei Cottbus, Prussia, associated with *Brasenia*, &c. (C. Weber); at Honerdingen in Hanover (C. Weber); and in Sweden in the Birch, Pine, Oak, and Spruce Zones (Neolithic) (Gunnar Andersson).

The exact date of the Alluvium at Happisburgh and at Lodmoor, near Weymouth, cannot be fixed.

Brasenia purpurea, Mich.

This species, though found in Africa, Asia, Australia, and America, is unknown living in Europe.

It occurs in the fossil state in Russia, Denmark, Germany, and Switzerland (Gunnar Andersson); but has not yet been found in Britain.

Papaver somniferum, L.

Neolithic (?)—

Cowden Glen, Renfrewshire.

The Opium Poppy was cultivated in Neolithic times, and its seeds have been found in the Swiss Lake-dwellings. The deposit at Cowden Glen is considered by Professor James Geikie to be of Interglacial age; but the occurrence in it of *Papaver somniferum* suggests a more modern date.

Papaver Argemone, L.

Roman Period:—

Silchester, Hampshire.

CHELIDONIUM MAJUS, L.

Interglacial:—

West Wittering, Sussex.

Five well-preserved and characteristic seeds have been found.

FUMARIA OFFICINALIS, L.

Neolithic:—

Redhall, near Edinburgh.

This plant has only been found associated with flax and weeds of cultivation.

THLASPI ARVENSE, L.

Roman Period:—

Silchester, Hampshire.

CAKILE MARITIMA, Scop.

Unknown fossil in Britain, but occurs in the Oak Zone (Neolithic) in Gotland (Gunnar Andersson).

VIOLA PALUSTRIS, L.

Neolithic:—

Drope, Glamorgan (?); Fillyside, near Edinburgh (raised beach.)

Lacustrine deposits of the Scottish Lowlands, Hailes, Redhall, near Edinburgh; Elie, Fife (?).

Late Glacial:—

Hoxne, Suffolk (bed C); Kirk Michael, and Close y Garey, Isle of Man; Hailes (lower bed); Corstorphine, Gayfield, near Edinburgh; Dronachy, Fife.

Interglacial:—

Allenton, near Derby; Faskine, Lanark.

Preglacial (Cromer Forest-bed):—

Mundesley, Norfolk; Pakefield, Suffolk.

SILENE MARITIMA, With.

Interglacial:—

West Wittering, Sussex.

LYCHNIS ALBA, Mill.

Neolithic:—

Elie, Fife.

LYCHNIS DIURNA, Sibth.

Neolithic:—

Lacustrine deposits of the Scottish Lowlands, Hailes, Redhall, Elie (?); Fillyside, near Edinburgh (raised beach) (?).

Late Glacial:—

Hailes, near Edinburgh (lower bed).

Interglacial:—

West Wittering, Sussex.

LYCHNIS FLOS-CUCULI, L.

Roman Period:—

Silchester, Hampshire.

Neolithic:—

Redhall, near Edinburgh (capsules and seeds); Hailes, near Edinburgh.

Late Glacial:—

Garvel Park (Clyde Beds).

Interglacial:—

West Wittering, Sussex.

STELLARIA AQUATICA, Scopoli.

Interglacial:—

West Wittering, Sussex.

Preglacial (Cromer Forest-bed):—

Beeston, Norfolk.

STELLARIA MEDIA, Cyr.

Roman Period :—

Silchester, Hampshire.

Neolithic :—

Fillyside, near Edinburgh (raised beach); lacustrine deposits of the Scottish Lowlands, Hailes, Redhall, Elie, Broughton.

Late Glacial :—

Twickenham, Middlesex; Hoxne, Suffolk (bed C); Hailes, near Edinburgh (lower bed); Corstorphine, near Edinburgh.

Interglacial :—

West Wittering, Sussex; Endsleigh Street, London.

Preglacial (Cromer Forest-bed):—

Overstrand, Norfolk.

STELLARIA HOLOSTEA, L.

Interglacial :—

West Wittering, Sussex.

STELLARIA GRAMINEA, L.

Roman Period :—

Silchester, Hampshire.

STELLARIA ULIGINOSA, L.

Neolithic :—

Redhall, near Edinburgh; Hailes, near Edinburgh.

ARENARIA TRINERVIA, L.

Not yet found fossil in Britain; but recorded by Keilhack and Nathorst from Lauenburg an der Elbe, where it is associated with *Brasenia purpurea.*

Arenaria peploides, L.

Interglacial:—

Stone, Hampshire.

Spergula arvensis, L.

Neolithic:—

Redhall, near Edinburgh.

Montia fontana, L.

Neolithic:—

Fillyside, near Edinburgh (raised beach); lacustrine deposits of the Scottish Lowlands, Redhall, Hailes Broughton, near Edinburgh; Cowden Glen, Renfrewshire.

Late Glacial:—

Twickenham, Middlesex; Hoxne, Suffolk (bed C).

Interglacial:—

Hitchin, Hertfordshire; Hoxne, Suffolk (bed D); Allenton, near Derby; West Wittering, Sussex.

Hypericum perforatum, L.

Roman Period:—

Silchester, Hampshire.

Interglacial:—

West Wittering, Sussex.

Hypericum quadrangulum, L.

Neolithic (?)—

Redhall, near Edinburgh.

Interglacial:—

West Wittering, Sussex.

Preglacial (Cromer Forest-bed):—

Pakefield, Suffolk.

HYPERICUM ELODES, L.

Neolithic (?)—

Redhall, near Edinburgh.

TILIA PLATYPHYLLOS, Scop.

Unknown fossil in Britain.

Recorded from Grünenthal and Fahrenkrug, in Holstein (associated with *Brasenia*, &c.) (C. Weber); Lauenburg an der Elbe (with *Brasenia*, &c.) (Keilhack and Nathorst); Klinge bei Cottbus, Prussia (with *Brasenia*, *Najas marina*, &c.) (C. Weber); Honerdingen, in Hanover, associated with *Tilia parvifolia* and *T. intermedia* (C. Weber).

Tilia europea is recorded from the Pine and Oak Zones in South Sweden (Gunnar Andersson).

LINUM, sp.

Roman Period :—

Silchester, Hampshire.

Neolithic :—

Lacustrine deposits of the Scottish Lowlands, Redhall, Hailes, Elie.

Capsules and seeds of flax are so common at Redhall as to suggest that bundles of the plant were steeped there. Flax is known to have been cultivated in Neolithic times.

GERANIUM COLUMBINUM, L.

No species of *Geranium* has yet been found fossil in Britain, with the doubtful exception of a seed from Endsleigh St., London.

G. columbinium is recorded by Keilhack from Lauenburg an der Elbe (associated with *Brasenia*).

Oxalis Acetosella, L.

Neolithic :—

Crossness, Essex (upper bed) ; Redhall, near Edinburgh ; Hailes, near Edinburgh.

Late Glacial :—

Hailes, near Edinburgh (lower bed).

Ilex Aquifolium, L.

Neolithic :—

Crossness, Essex (upper and lower peats).

Interglacial :—

West Wittering, Sussex.

Also recorded from Grünenthal, in Holstein ; Klinge bei Cottbus, in Prussia (associated with *Brasenia*, *Najas marina*, &c.) ; Honerdingen, in Hanover (C. Weber).

Rhamnus Frangula, L.

Interglacial :—

Hoxne (bed D) ; West Wittering, Sussex.

Recorded from Honerdingen, in Hanover (C. Weber) ; Lauenburg an der Elbe (A. G. Nathorst) ; and from the Pine and Oak Zones in Sweden (Gunnar Andersson).

Vitis vinifera, L.

A portion of a stem discovered by Mr. Worthington Smith in the Palæolithic deposits of Stoke Newington was so determined by Mr. Carruthers. The specimen has unfortunately been mislaid, but Mr. Smith thinks that it is probably a recent stem accidentally introduced ; he has found several such in ground disturbed during the Roman occupation.

Acer campestre, L.

Neolithic:—

Crossness, Essex (upper and lower peats).

Preglacial (Cromer Forest-bed)—:

Pakefield, Suffolk.

Also recorded from the Oak Zone in Sweden (Gunnar Andersson); and from Fahrenkrug, in Holstein, and Klinge bei Cottbus, in Prussia (associated with *Brasenia*) (C. Weber).

Acer monspessulanum, L.

Interglacial:—

Stone, Hampshire; Selsey, Sussex.

This maple lives throughout the Mediterranean region and extends into central Europe; it grows well in gardens in the South of England and seeds freely.

Acer platanoides, L.

Recorded by Gunnar Andersson from the Oak Zone in South Sweden; and by Keilhack from Lauenburg an der Elbe, associated with *Brasenia*. It has not been found in Britain.

Prunus spinosa, L.

Neolithic:—

Crossness, Essex (upper and lower peats); Northampton; Hailes, near Edinburgh.

Interglacial:—

Hitchin, Hertfordshire; West Wittering, Sussex.

Preglacial (Cromer Forest-bed):—

West Runton, Overstrand, Happisburgh (Norfolk), Pakefield, Suffolk.

PRUNUS DOMESTICA, L.

Neolithic:—

Crossness, Essex (upper peat).

In 'Etudes d'Ethnographie Préhistorique.—II. Les Plantes cultivées de la Période de Transition au Mas-d'Azil,' (*Anthropologie*, Vol. VII., No. I., pp. 1–24), Monsieur Ed. Piette has given a good account and figures of the early cultivated species of *Prunus*. We have not yet obtained in Britain sufficient material for a similar analysis.

PRUNUS AVIUM, L.

Neolithic:—

Crossness, Essex (upper and lower peats); Gayfield, Edinburgh.

Interglacial:—

West Wittering, Sussex; Selsey, Sussex.

PRUNUS PADUS, L.

Neolithic:—

Northampton; Hornsea, Yorkshire; Sand le Meer, Yorkshire; Hailes, near Edinburgh.

Interglacial:—

Selsey, Sussex; Airdrie, Lanarkshire.

Recorded from the Pine and Oak Zones (Neolithic) in Sweden (Gunnar Andersson).

SPIRÆA ULMARIA, L.

Roman Period:—

Silchester, Hampshire.

Neolithic:—

Hailes, near Edinburgh; Redhall, near Edinburgh.

Interglacial:—

West Wittering, Sussex.

Recorded also from the Pine and Spruce Zones (Neolithic) in Sweden (Gunnar Andersson).

Preglacial (Cromer Forest-bed):—

Pakefield, Suffolk.

RUBUS IDÆUS, L.

Neolithic:—

Southampton Docks (?); Lacustrine deposits of the Scottish Lowlands at Hailes, Redhall, Elie, Cowden Glen; Fillyside, near Edinburgh, (raised beach).

Late Glacial:—

Hoxne, Suffolk (bed C); Gayfield, near Edinburgh; Garvel Park (Clyde Beds); Black Burn, East Tarbet (Clyde Beds).

Interglacial:—

Shacklewell, London; Hoxne, Suffolk (beds D and E); Allenton, near Derby.

Early Glacial:—

Beeston, Norfolk (at the base of the Arctic plant-bed).

RUBUS FRUTICOSUS, L.

Roman Period:—

Silchester, Hampshire.

Neolithic:—

Crossness, Essex (upper and lower peats).

Hailes, near Edinburgh; Redhall, near Edinburgh.

Interglacial:—

Stone, Hants; West Wittering, Sussex; Selsey, Sussex; Grays, Essex.

Preglacial (Cromer Forest-bed):—

Overstrand; Mundesley; Pakefield.

Rubus cæsius, L.

Unknown fossil in Britain.

Recorded with doubt by Gunnar Andersson from the Oak Zone in South Sweden.

Rubus saxatilis, L.

Unknown fossil in Britain.

Recorded by Gunnar Andersson from the Pine, Oak, and Spruce Zones in Sweden.

Dryas octopetala, L.

Late Glacial:—

Corstorphine, near Edinburgh; Crianlarich, Perthshire.

This species, though rare fossil in Britain, is very abundant in similar deposits in Scandinavia.

Potentilla Tormentilla, Neck.

Roman Period:—

Silchester, Hampshire.

Neolithic:—

Ballaugh, Isle of Man (bed A); Close y Garey, Isle of Man (bed B); Hailes, near Edinburgh; Redhall, near Edinburgh; Elie, Fife.

Late Glacial:—

Roxburgh Street, Greenock (?).

Interglacial:—

Endsleigh Street, London; West Wittering, Sussex.

POTENTILLA COMARUM, Nestl.

Neolithic:—

Redhill, near Edinburgh; Hailes, near Edinburgh.

Late Glacial:—

Kirk Michael, Isle of Man; Close y Garey, Isle of Man.

Interglacial:—

Airdrie, Lanarkshire.

ALCHEMILLA ARVENSIS, Lam.

Roman Period:—

Silchester, Hampshire.

Neolithic:—

Redhall, near Edinburgh.

Interglacial:—

West Wittering, Sussex.

As only a single achene has been sent to me from Redhall, this may possibly be a recent specimen accidentally introduced. At West Wittering achenes are fairly common.

POTERIUM OFFICINALE, Hook.

Neolithic:—

Redhall, near Edinburgh; Cowden Glen, Renfrewshire.

Late Glacial:—

Hoxne, Suffolk (bed C); Ballaugh, Isle of Man (bed C); Corstorphine, near Edinburgh.

Interglacial:—

West Wittering, Sussex; Hitchin, Hertfordshire; South-elmham, Suffolk.

Early Glacial:—

Beeston, Norfolk (at base of the Arctic Freshwater bed).

Preglacial (Cromer Forest-bed):—

Beeston, Sidestrand, Mundesley, in Norfolk.

ROSA.

Neolithic:—

Crossness, Essex (upper and lower peats); Redhall, near Edinburgh (?).

Interglacial:—

West Wittering, Sussex; Selsey, Sussex; Stone, Hampshire; Grays, Essex; Shacklewell, London; Hoxne, Suffolk (bed D).

Prickles and achenes are not uncommon at several localities. The achenes are always short in proportion to their breadth, and very small; the prickles are generally curved and small. I have seen nothing approaching to the common living forms of *R. canina*, L.; and the fossils more suggest a species with small globose fruits.

PYRUS TORMINALIS, Ehrh.

Interglacial:—

Hitchin, Hertfordshire; Hoxne, Suffolk (bed D).

PYRUS ARIA, Sm.

Preglacial (Cromer Forest-bed) :—

Pakefield, Suffolk (leaves).

PYRUS AUCUPARIA, Gaert.

Neolithic :—

Caerwys, Flintshire.

Recorded from the Pine, Oak, and Spruce Zones (Neolithic) in Sweden (Gunnar Andersson).

PYRUS COMMUNIS, L.

Neolithic :—

Crossness, Essex (upper and lower peats), (wood determined by Professor Marshall Ward).

CRATÆGUS OXYACANTHA, L.

Neolithic :—

Barry Docks, Glamorgan; Crossness, Essex (upper and lower peats); Redhall, near Edinburgh; Hailes, near Edinburgh; Gayfield near Edinburgh.

Interglacial :—

Southelmham, Suffolk.

Preglacial (Cromer Forest-bed) :—

Overstrand, Norfolk.

In the Swedish peat-mosses only the form *Cratægus monogyna* occurs (Gunnar Andersson).

SAXIFRAGA OPPOSITIFOLIA, L.

Unknown fossil in Britain.

Recorded from Deuben, in Saxony (Nathorst), associated with *Salix herbacea*, &c.

Saxifraga Hirculus, L.

Unknown fossil in Britain.

Recorded from Deuben, in Saxony (Nathorst).

Saxifraga aizoides, L.

Unknown fossil in Britain.

Recorded from Deuben, in Saxony (Nathorst).

Hippuris vulgaris, L.

Neolithic :—

Drope, Glamorgan ; Crossness, Essex (upper peat) ; Hailes, near Edinburgh ; Cowden Glen, Renfrewshire.

Late Glacial :—

Hoxne, Suffolk (bed C) ; Kirk Michael, Isle of Man ; Corstorphine, near Edinburgh ; Hailes, near Edinburgh (lower bed) ; Dronachy, Fife.

Interglacial :—

West Wittering, Sussex ; Endsleigh Street, London ; Hitchin, Hertfordshire ; Hoxne, Suffolk (bed E) ; South-elmham, Suffolk ; Faskine, Lanark ; Airdrie, Lanark ; Kilmaurs, Ayrshire.

Early Glacial :—

Beeston, Norfolk (at base of Arctic Freshwater bed) ; Ostend, Norfolk.

Preglacial (Cromer Forest-bed) :—

Beeston, Cromer, Sidestrand, Mundesley, Ostend (Norfolk).

Myriophyllum spicatum, L.

Neolithic :—

Lacustrine deposits of the Scottish Lowlands, Gayfield, Cowden Glen ; Megaceros-marls of Ireland.

Late Glacial :—

Hoxne, Suffolk (bed C) ; Corstorphine ; Dronachy, Fife ; Close y Garey, Isle of Man (bed C).

Interglacial :—

West Wittering, Sussex ; Endsleigh Street, London ; Hitchin, Hertfordshire (?) ; Southelmham, Suffolk ; Kilmaurs, Ayrshire.

Early Glacial :—

Beeston, Norfolk (3 doubtful fruits).

Preglacial (Cromer Forest-bed) :—

Cromer, Overstrand, Sidestrand, Mundesley, in Norfolk ; Pakefield, in Suffolk.

Myriophyllum alternifolium, L.

Unknown fossil in Britain.

Recorded from the Pine Zone (Neolithic) in Sweden (Gunnar Andersson).

Trapa natans, L.

Preglacial (Cromer Forest-bed) :—

Sidestrand, Mundesley, Ostend (Norfolk) ; Pakefield, in Suffolk.

This plant does not occur in Britain in deposits later than the Cromer Forest-bed. In Scandinavia, however, it is common in Postglacial peaty deposits, extending also into Finland. At Lauenburg an der Elbe it occurs associated with *Brasenia* (Keilhack); and at Grünenthal, in Holstein, under similar conditions (Weber); both these deposits being apparently of Interglacial date. As a living species it still lingers in Southern Sweden, and is more common in Southern Europe, where the fruits are eaten.

Hydrocotyle vulgaris, L.

Neolithic (?)—

Ballaugh, Isle of Man (bed A); Elie, Fife.

Interglacial :—

West Wittering, Sussex; Southelmham, Suffolk; Allenton, near Derby.

Preglacial (Cromer Forest-bed) :—

Corton, Suffolk; Pakefield, Suffolk.

Apium graveolens, L.

Interglacial :—

West Wittering, Sussex.

Apium nodiflorum, Reich.

Interglacial:—

Airdrie, Lanark; West Wittering, Sussex.

Cicuta virosa, L.

Unknown fossil in Britain.

Recorded from the Pine, Oak, and Spruce Zones (Neolithic) in Scandinavia (Gunnar Andersson).

Carum Carui, L.

This plant is only represented by a single well-preserved fruit from Redhall. In the absence of corroborative evidence, and considering how largely carraway-seeds are used for cakes, it does not seem advisable to include this species in the list of British fossil plants.

Sium latifolium, L.

Unknown fossil in Britain.

Recorded from the Pine and Oak Zones (Neolithic) in Sweden (Gunnar Andersson).

Conopodium denudatum, Koch.

Roman Period:—

Silchester, Hampshire.

Chærophyllum temulum, L.

Interglacial:—

West Wittering, Sussex.

Anthriscus sylvestris, Hoffm.

Interglacial:—

West Wittering, Sussex.

Œnanthe fistulosa, L.

Interglacial:—

West Wittering, Sussex.

Œnanthe Lachenalii, Gmel.

Late Glacial:—

Garvel Park (Clyde Beds).

Preglacial (Cromer Forest-bed):—

Mundesley, Norfolk; Pakefield, Suffolk.

Œnanthe Phellandrium, Lam.

Neolithic:—

Crossness, Essex (upper peat).

Late Glacial:—

Hoxne, Suffolk (bed C).

Interglacial:—

West Wittering, Sussex; Hoxne, Suffolk (bed D); Southelmham, Suffolk.

Preglacial (Cromer Forest-bed):—

Sidestrand, Mundesley, Beeston, in Norfolk; Pakefield, in Suffolk.

Æthusa Cynapium, L.

Roman Period:—

Silchester, Hampshire.

Neolithic:—

Hailes, near Edinburgh; Elie, Fife.

In each case there is some doubt as to the age of the deposit.

Angelica sylvestris, L.

Interglacial:—

West Wittering, Sussex.

Also recorded from the Oak Zone (Neolithic) Gotland (Gunnar Andersson).

Peucedanum palustre, Mœnch.

Unknown Fossil in Britain.

Recorded from the Oak Zone (Neolithic) in Gotland (Gunnar Andersson).

Heracleum Sphondylium, L.

Late Glacial:—

Twickenham, Middlesex.

Preglacial (Cromer Forest-bed):—

Pakefield, Suffolk.

Caucalis nodosa, Scop.

Interglacial:—

Stone, Hampshire.

Hedera Helix, L.

Neolithic:—

Crossness, Essex (upper and lower peats) (Spurrell); Caerwys, Flintshire.

Interglacial:—

Grays, Essex.

Recorded also from the Oak Zone (Neolithic) in Gotland (Gunnar Andersson).

Cornus suecica, L.

Unknown fossil in Britain.

Recorded from Gotland, in South Sweden, associated with Arctic plants.

Cornus sanguinea, L.

Neolithic:—

Barry Docks, South Wales; Crossness, Essex (upper and lower peats); Albert Dock, Essex.

Interglacial:—

West Wittering, Sussex; Hitchin, Hertfordshire; Hoxne, Suffolk (a single fruit, not found in place and perhaps recent).

Preglacial (Cromer Forest-bed):—

Happisburgh, Norfolk; Pakefield, Suffolk.

SAMBUCUS NIGRA, L

Roman Period:—

Silchester, Hampshire.

Neolithic:—

Southampton Docks (peat below sea-level); Crossness, Essex (upper and lower peats); Northampton (old river-bed); Hailes, near Edinburgh; Redhall, near Edinburgh; Fillyside, near Edinburgh (in raised beach).

Late Glacial:—

Hoxne, Suffolk (bed C—perhaps derivative from bed D).

Interglacial:—

West Wittering, Sussex; Hitchin, Hertfordshire; Hoxne, Suffolk (bed D).

VIBURNUM OPULUS, L.

Neolithic:—

Crossness, Essex (upper and lower peats).

Interglacial:—

West Wittering, Sussex.

VIBURNUM LANTANA, Linn.

Interglacial:—

West Wittering, Sussex.

GALIUM BOREALE, L.

Early Glacial:—

Beeston, Norfolk (one badly preserved fruit of *Galium* perhaps belongs to this species).

GALIUM PALUSTRE, L.

Neolithic:—

Cowden Glen, Renfrewshire.

Recorded by C. Weber with doubt from Klinge bei Cottbus, Prussia, associated with *Brasenia.*

GALIUM ULIGINOSUM, L.

Unknown fossil in Britain.

Recorded from an Interglacial deposit at Grünenthal, in Holstein (Weber).

GALIUM APARINE, L.

Neolithic (?)—

Casewick, Lincolnshire.

VALERIANA OFFICINALIS, L.

Neolithic:—

Barry Docks, South Wales; lacustrine deposits of the Scottish Lowlands, Hailes, Redhall, Elie.

Interglacial:—

Allenton, near Derby; Stone, Hampshire.

VALERIANELLA OLITORIA, Mœnch.

Interglacial:—

West Wittering, Sussex.

SCABIOSA SUCCISA, L.

Interglacial:—

West Wittering, Sussex.

EUPATORIUM CANNABINUM, L.

Neolithic:—

Tilbury Docks (peat below sea-level); Redhall, near Edinburgh.

Late Glacial:—

Hoxne, Suffolk (bed C).

Interglacial:—

West Wittering, Sussex; Shacklewell, London; Hitchin, Hertfordshire; Hoxne, Suffolk (bed D); Allenton, near Derby.

ASTER TRIPOLIUM, L.

Interglacial:—

West Wittering, Sussex.

BIDENS CERNUA, L.

Neolithic:—

Redhall, near Edinburgh.

The fruit from Hoxne, referred in 1888 to this species, is a variety of *B. tripartita* with four equal awns.

BIDENS TRIPARTITA, L.

Late Glacial:—

Hoxne, Suffolk (bed C—a starved fruit).

Interglacial:—

Hoxne, Suffolk (bed D), associated with a variety having four equal awns.

Preglacial (Cromer Forest-bed):—

Mundesley, Norfolk; Pakefield, Suffolk.

CHRYSANTHEMUM SEGETUM, L.

Neolithic:—

Hailes, near Edinburgh; Redhall, near Edinburgh.

CHRYSANTHEMUM LEUCANTHEMUM, L.

Roman Period:—

Silchester, Hampshire.

A single fruit of this species, sent to me as from the

Arctic bed at Hailes, near Edinburgh, is probably recent; it is not carbonised, and the ribs are light-brown.

MATRICARIA INODORA, L.

Neolithic:—

Redhall, near Edinburgh; Hailes, near Edinburgh.

Only found associated with weeds of cultivation.

TANACETUM VULGARE, L.

Early Glacial:—

Beeston, Norfolk (base of the Arctic Freshwater bed).

TUSSILAGO FARFARA, L.

Neolithic:—

Redhall, near Edinburgh (a single fruit).

SENECIO SYLVATICUS, L.

Neolithic:—

Redhall, near Edinburgh.

SENECIO AQUATICUS, Huds.

Interglacial:—

West Wittering, Sussex.

CARDUUS CRISPUS, L.

Neolithic:—

Close y Garey, Isle of Man (bed B).

CNICUS LANCEOLATUS, L.

Neolithic:—

Redhall, near Edinburgh (fruits rather small); Elie, Fife.

Interglacial:—

West Wittering, Sussex.

CNICUS PALUSTRIS, L.

Neolithic:—

Hailes, near Edinburgh; Redhall, near Edinburgh.

Interglacial:—

Southelmham, Suffolk (fruits small); West Wittering, Sussex.

CENTAUREA CYANUS, L.

Neolithic:—

Redhall, near Edinburgh.

With weeds of cultivation and flax-seeds.

LAPSANA COMMUNIS, L.

Neolithic:—

Redhall, near Edinburgh; Hailes, near Edinburgh (fruit very small).

Interglacial:—

West Wittering, Sussex.

Preglacial Cromer Forest-bed):—

Pakefield, Suffolk.

PICRIS HIERACIOIDES, L.

Preglacial (Cromer Forest-bed):—

Pakefield, Suffolk.

CREPIS VIRENS, L.

Neolithic:—

Redhall, near Edinburgh.

HIERACIUM PILOSELLA, L.

Interglacial:—

West Wittering, Sussex.

No trace of any other species of *Hieracium* has yet been found fossil in Britain.

Leontodon autumnalis, L.

Neolithic :—

Redhall, near Edinburgh.

Interglacial :—

Allenton, near Derby.

Taraxacum officinale, Web.

Neolithic :—

Redhall, near Edinburgh; Fillyside, near Edinburgh (raised beach).

Late Glacial :—

Hoxne, Suffolk (bed C); Hailes, near Edinburgh (lower bed); Corstorphine, near Edinburgh; Garvel Park (Clyde Beds); Roxburgh Street, Greenock (in glacial clay).

Interglacial :—

Southelmham, Suffolk; Allenton, near Derby; West Wittering, Sussex.

Sonchus arvensis, L.

Neolithic :—

Lacustrine deposits of the Scottish Lowlands, Redhall, and Gayfield, near Edinburgh.

Vaccinium Oxycoccos, L.

Unknown fossil in Britain.

Recorded from Fahrenkrug in Holstein (C. Weber); Lauenburg an der Elbe (Keilhack); Klinge bei Cottbus, in Prussia (C. Weber); at all three localities being associated with *Brasenia purpurea.* Also from the Pine, Oak, and Spruce Zones in Sweden (Gunnar Andersson).

Vaccinium Vitis-Idæa, Linn.

Unknown fossil in Britain.

Recorded from the Pine, Oak, and Spruce Zones in Sweden (Gunnar Andersson); also in deposits apparently of Late Glacial date at Grünenthal, in Holstein (Weber).

Vaccinium uliginosum, L.

Unknown fossil in Britain.

Recorded from Fahrenkrug in Holstein (associated with *Brasenia*) (C. Weber); and in the Dryas, Birch, Pine, Oak, and Spruce Zones in Sweden (Gunnar Andersson).

Vaccinium Myrtillus, L.

Twigs are recorded from Cowden Glen by Dr. Craig. I can find no recognisable seeds or leaves of this species in the material sent me by Mr. Bennie, and doubt whether twigs alone would be sufficient for determination.

Recorded from a deposit apparently of Late Glacial date at Grünenthal, in Holstein (C. Weber).

Arctostaphylos alpina, Spreng.

Unknown fossil in Britain.

Recorded from the Dryas Zone in Gotland (Gunnar Andersson).

Arctostaphylos Uva-ursi, Spreng.

Late Glacial (?)—

Bovey Tracey, Devon (A. G. Nathorst).

Also recorded from the Dryas, Birch, Pine, and Oak Zones in Gotland, Sweden (Gunnar Andersson).

ANDROMEDA POLIFOLIA, L.

Late Glacial:—

Hailes, near Edinburgh (lower bed); Corstorphine, near Edinburgh.

LOISELEURIA PROCUMBENS, Desv.

Late Glacial :—

Corstorphine, near Edinburgh.

GLAUX MARITIMA, L.

Interglacial :—

West Wittering, Sussex.

FRAXINUS EXCELSIOR, L.

Neolithic :—

Crossness, Essex (upper and lower peats), wood determined by Prof. Marshall Ward.

Interglacial :—

Hitchin, Hertfordshire.

In Sweden confined to the Oak Zone (Gunnar Andersson) ; recorded from Honerdingen in Hanover, associated with *Platanus*, *Juglans*, and *Najas flexilis* (C. Weber).

MENYANTHES TRIFOLIATA, L.

Neolithic :—

Drope, Glamorgan ; Redhall, near Edinburgh ; Gayfield, near Edinburgh ; Hailes, near Edinburgh; Elie, Fife; Cowden Glen, Renfrewshire ; Montrose (in peat below 20 feet of estuarine deposits).

Late Glacial :—

Hoxne, Suffolk (bed C); Kirk Michael, Isle of Man; Hailes, near Edinburgh (lower bed); Gayfield and Corstorphine, near Edinburgh; Dronachy, Fife.

Interglacial :—

West Wittering, Sussex; Hitchin, Hertfordshire; Southelmham, Suffolk; Airdrie, Lanark.

Early Glacial : —

Beeston, Norfolk (base of Arctic Freshwater bed).

Preglacial (Cromer Forest-bed) :—

Cromer, Mundesley, Happisburgh (in Norfolk).

MYOSOTIS SYLVATICA, Hoffm.

Recorded from Gotland, Sweden, by Dr. Gunnar Andersson. No species of *Myosotis* has yet been found fossil in Britain, *M. lingulata* being a wrong determination.

SOLANUM DULCAMARA, L.

Interglacial :—

West Wittering, Sussex.

Recorded from the Pine and Oak Zones in South Sweden (Gunnar Andersson).

Preglacial (Cromer Forest-bed) :—

Corton, Suffolk.

VERBASCUM THASPUS, L.

Interglacial :—

West Wittering, Sussex.

BARTSIA ODONTITES, Huds.

Late Glacial :—

Garvel Park (Clyde Beds), four seeds received from Mr. Thos. Scott.

PEDICULARIS PALUSTRIS, L.

Neolithic :—

Hailes, near Edinburgh; Redhall, near Edinburgh; Cowden Glen, Renfrewshire.

MENTHA AQUATICA, L.

Roman Period :—

Silchester, Hampshire.

Interglacial :—

Hoxne, Suffolk (bed D); West Wittering, Sussex; Stone, Hampshire.

Preglacial (Cromer Forest-bed) :—

Pakefield, Suffolk.

This plant may be common at other localities, the small size of its nutlets having caused it to be overlooked till specially searched for.

LYCOPUS EUROPÆUS, L.

Neolithic :—

Redhall, near Edinburgh; Hailes, near Edinburgh.

Late Glacial :—

Hoxne, Suffolk (bed C).

Interglacial :—

West Wittering, Sussex; Stone, Hampshire; Shacklewell, London; Hitchin, Hertfordshire; Hoxne, Suffolk (bed D); Southelmham, Suffolk.

Preglacial (Cromer Forest-bed) :—

Mundesley, Norfolk ; Pakefield, Suffolk.

THYMUS SERPYLLUM, L.

Late Glacial :—

Greenock (Roxburgh Street), in Clyde Beds.

PRUNELLA VULGARIS, L.

Roman Period :—

Silchester, Hampshire.

Neolithic :—

Redhall, near Edinburgh.

STACHYS PALUSTRIS, L.

Neolithic :—

Redhall, near Edinburgh ; Hailes, near Edinburgh ; Fillyside, near Edinburgh (raised beach).

Late Glacial :—

Hailes, near Edinburgh (lower bed).

Interglacial :—

Hoxne Suffolk (bed D), one badly preserved nutlet perhaps belongs to this species ; West Wittering, Sussex.

Preglacial (Cromer Forest-bed) :—

Beeston, Norfolk.

STACHYS SYLVATICA, L.

Unknown fossil in Britain.

Recorded from the Dryas and Pine Zones (Late Glacial and Neolithic) in Sweden (Gunnar Andersson).

STACHYS ARVENSIS, L.

Roman Period :—

Silchester, Hampshire.

GALEOPSIS TETRAHIT, L.

Roman Period :—

Silchester, Hampshire.

Neolithic :—

Hailes, near Edinburgh ; Redhall, near Edinburgh ; Cowden Glen, Renfrewshire.

Late Glacial :—

Twickenham, Middlesex.

The occurrence of *Galeopsis Tetrahit*, often considered to be a weed of cultivation, at Twickenham associated with Reindeer, Bison, and *Bos longifrons*, but not with extinct mammals, suggests a transition period between Palæolithic and Neolithic.

AJUGA REPTANS, L.

Neolithic :—

Redhall, near Edinburgh ; Hailes, near Edinburgh ; Fillyside, near Edinburgh (raised beach) ; Elie, Fife ; Cowden Glen, Renfrewshire.

Late Glacial :—

Hoxne, Suffolk (bed C) ; Hailes, near Edinburgh (lower bed).

Interglacial :—

Selsey, Sussex ; West Wittering, Sussex ; Hitchin, Hertfordshire ; Allenton, near Derby.

LITTORELLA LACUSTRIS, L.

Neolithic :—

Redhall, near Edinburgh ; Megaceros-marls of Central Ireland.

Late Glacial :—

Ballaugh, Isle of Man.

ATRIPLEX PATULA, L.

Neolithic :—

Casewick, Lincolnshire; Hailes, near Edinburgh; Redhall, near Edinburgh; Fillyside, near Edinburgh (raised beach); Elie, Fife.

Late Glacial :—

Garvel Park (Clyde Beds); Roxburgh Street, Greenock (Clyde Beds).

Interglacial :—

Stone, Hampshire; West Wittering, Sussex; Selsey, Sussex.

Preglacial (Cromer Forest-bed) :—

Beeston, West Runton, Sidestrand (in Norfolk); Corton, Pakefield (in Suffolk).

POLYGONUM AVICULARE, L.

Roman Period :—

Silchester, Hampshire.

Neolithic :—

Redhall, near Edinburgh; Broughton, near Edinburgh.

Late Glacial :—

Hailes, near Edinburgh (lower bed).

Interglacial :—

Endsleigh Street, London; Stone, Hampshire; Selsey, Sussex.

POLYGONUM HYDROPIPER, L.

Neolithic :—

Crossness, Essex (lower peat).

POLYGONUM PERSICARIA, L.

Neolithic :—

Lacustrine deposits of the Scottish Lowlands, Hailes, Redhall, Gayfield, Broughton, Elie.

Late Glacial :—

Twickenham, Middlesex.

Interglacial :—

West Wittering, Sussex ; Endsleigh Street, London.

Preglacial (Cromer Forest-bed):—

Pakefield, Suffolk.

POLYGONUM LAPATHIFOLIUM, L.

Neolithic (?) :—

Cowden Glen, Renfrewshire.

POLYGONUM AMPHIBIUM, L.

Unknown fossil in Britain.

Recorded by Dr. Gunnar Andersson from South Sweden.

POLYGONUM VIVIPARUM, L.

Unknown fossil in Britain.

Recorded from the Dryas Zone of Gotland (Gunnar Andersson); and from Deuben, in Saxony (A. G. Nathorst).

OXYRIA DIGYNA, Hill.

Late Glacial :—

Corstorphine, near Edinburgh.

RUMEX CONGLOMERATUS, Murr.

Roman Period :—

Silchester, Hampshire.

Interglacial :—

West Wittering, Sussex.

RUMEX MARITIMUS, L.

Late Glacial :—

Hoxne, Suffolk (bed C).

Interglacial :—

Hoxne, Suffolk (beds D and E); Southelmham, Suffolk.

Early Glacial :—

Beeston, Norfolk (base of Arctic Freshwater bed).

Preglacial (Cromer Forest-bed) :—

Beeston, West Runton, Overstrand, Sidestrand, Ostend (in Norfolk); Pakefield (in Suffolk).

RUMEX OBTUSIFOLIUS, L.

Neolithic :—

Redhall, near Edinburgh.

Late Glacial :—

Close y Garey, Isle of Man (in Megaceros-marl).

Interglacial :—

West Wittering, Sussex; Endsleigh Street, London.

RUMEX CRISPUS, L.

Neolithic :—

Barry Docks, Glamorgan; Casewick, Lincolnshire; Redhall, near Edinburgh; Hailes, near Edinburgh; Cowden Glen, Renfrewshire.

Late Glacial :—

Twickenham, Middlesex; Hoxne, Suffolk (bed C) (?); Garvel Park (Clyde Beds).

Interglacial :—

Hoxne, Suffolk (bed D) ; West Wittering, Sussex.

Preglacial (Cromer Forest-bed) :—

Sidestrand, Norfolk (?).

RUMEX HYDROLAPATHUM, Huds.

Unknown fossil in Britain.

Recorded from the Pine and Oak Zones (Neolithic) in Gotland (Gunnar Andersson).

RUMEX ACETOSELLA, L.

Interglacial :—

Hoxne, Suffolk (bed D) (?).

Preglacial (Cromer Forest-bed) :—

Beeston, Norfolk.

It is noteworthy that our two aquatic docks, *R. aquaticus* and *R. Hydrolapathum*, are still missing in the fossil state in Brltain.

HIPPOPHAE RHAMNOIDES, L.

Unknown fossil in Britain.

Recorded from Norrland in Sweden in calcareous tufa (Nathorst), and from Gotland (Gunnar Andersson).

VISCUM ALBUM, L.

Unknown fossil in Britain.

Recorded from the Oak Zone (Neolithic) in Gotland (Gunnar Andersson).

EUPHORBIA HELIOSCOPIA, L.

Neolithic:—

Redhall, near Edinburgh, with weeds of cultivation.

Euphorbia amygdaloides, L.

Preglacial (Cromer Forest-bed) :—

Mundesley, Norfolk; Pakefield, Suffolk.

Mercurialis perennis, L.

Neolithic:—

Crossness, Essex (upper and lower peats); Hailes, near Edinburgh; Fillyside, near Edinburgh (raised beach).

Interglacial:—

West Wittering, Sussex.

Ulmus montana, Sm.

Blashenwell, Dorset; Dursley, Gloucester (in calcareous tufa of doubtful age); Digby Fen (elm-wood recorded by Skertchly from a depth of 10 feet).

Interglacial:—

Grays, Essex (badly preserved leaves).

Preglacial (Cromer Forest-bed) :—

Happisburgh, Norfolk.

In each case the leaves are small, and more like *U. montana* than like *U. campestris.* The difference in the leaves is very slight, and I have not yet been able to obtain the more characteristic fruit.

Urtica dioica, L.

Late Glacial :—

Hoxne, Suffolk (bed C) (one seed, perhaps derived from the bed below).

Interglacial :—

Hoxne, Suffolk (bed D).

Myrica Gale, L.

Unknown fossil in Britain.

Recorded from the Oak Zone in Gotland, Sweden (Gunnar Andersson); from Fahrenkrug in Holstein associated with *Brasenia* (Carl Weber); and from Honerdingen, in Hanover, associated with *Platanus*, *Juglans*, and *Najas flexilis* (C. Weber).

Betula alba, L.

Neolithic:—

Drope, Glamorgan; Southampton Docks (recorded by Messrs. Shore & Elwes); Albert Dock, N. Woolwich; Crossness, Essex (in lower and upper peats), (Spurrell); Whittlesey Mere, Fenland (Skertchly); Caerwys, Flintshire; Hailes, near Edinburgh; Cowden Glen, Renfrewshire. Also common in peat-mosses nearly everywhere.

Late Glacial:—

Bovey Tracey, Devon (A. G. Nathorst); Close y Garey, Isle of Man; Crianlarich, Perthshire.

Interglacial:—

West Wittering, Sussex.

Preglacial (Cromer Forest-bed):—

Common nearly everywhere.

Betula nana, L.

Late Glacial:—

Bovey Tracey, Devon (Heer); Hoxne, Suffolk (bed C); Holmpton, East Yorkshire; Bridlington, Yorkshire (Nathorst); Corstorphine, near Edinburgh; Dronachy, Fife; Crianlarich, Perthshire.

Interglacial:—

Admiralty Offices, London; Airdrie, Lanark.

Early Glacial:—

Beeston, Norfolk; Ostend, Norfolk.

ALNUS GLUTINOSA, Linn.

Neolithic:—

Submerged peats of the Thames Valley at Tilbury Docks, Albert Docks, and Crossness; Kings Lynn; Hornsea, E. Yorkshire; Sand le Meer, E. Yorkshire; Redhall, near Edinburgh; Hailes, near Edinburgh; Fillyside, near Edinburgh (raised beach).

Late Glacial:—

Hoxne, Suffolk (bed C); Hailes, near Edinburgh (lower bed).

Interglacial:—

Grays, Essex; Shacklewell, London; Hitchin, Hertfordshire; Hoxne, Suffolk (beds D and E); Southelmham, Suffolk.

Early Glacial:—

Beeston, Norfolk (base of Arctic Freshwater Bed).

Preglacial (Cromer Forest-bed):—

At most localities in Norfolk and Suffolk.

CARPINUS BETULUS, L.

Interglacial:—

Hoxne, Suffolk (bed D).

Preglacial (Cromer Forest-bed):—

Pakefield, Suffolk.

Also recorded from Lauenburg an der Elbe (Keilhack); from Klinge bei Cottbus, in Prussia (Carl Weber); and from Grünenthal in Holstein (Carl Weber), in each case associated with *Brasenia*, &c.

CORYLUS AVELLANA, L.

Neolithic:—

Southampton Dock (submerged peat); Blashenwell, Dorset (in tufa); Barry Docks, Glamorgan; Albert Dock, Essex; Whittlesey Mere, Fenland (peat at 20 feet); Northampton; Sand le Meer, East Yorkshire; Hull; Hailes, near Edinburgh; Cowden Glen, Renfrewshire; and common in the 'submerged forests' nearly everywhere.

Interglacial:—

West Wittering, Sussex; Grays, Essex (a doubtful fragment of a nut); Hoxne, Suffolk (bed D); Overtown, near Beith, Ayrshire (between two tills) (Mr. C. Craig).

Preglacial (Cromer Forest-bed):—

Ostend, Norfolk; Pakefield, Suffolk.

The hazel, though so abundant in Postglacial deposits, is rare in the Interglacial and Preglacial strata.

QUERCUS ROBUR, L.

Neolithic:—

Common in the 'submerged forests' everywhere; Blashenwell, Dorset (in tufa); Northampton (old river bed); at base of peat mosses in Yorkshire up to a height of 1000 feet; Hailes and Redhall, near Edinburgh.

Interglacial:—

Stone, Hampshire; West Wittering, Sussex; Selsey, Sussex; Grays, Essex; Shacklewell, London; Hitchin, Hertfordshire; Hoxne, Suffolk (Prestwich).

Preglacial (Cromer Forest-bed):—

Ostend, Norfolk; Happisburgh, Norfolk; Pakefield, Suffolk.

CASTANEA SATIVA, Mill.

(Ridley, *Journ. Bot.*, 1885, p. 253.)

Charcoal of Chestnut was discovered by Mr. H. N. Ridley associated with Palæolithic implements between Crayford and Erith in Kent.

The Chestnut is not usually considered to be a native of Britain; but Mr. Ridley suggests that owing to the value of the fruit any trees found would be enclosed and become private property at an early date. I have not yet discovered any corroborative evidence; but as the tree is a dry-soil species it can only be expected to occur rarely in the fossil state. Large beams of Chestnut are not uncommon in old castles and abbeys; these may be of foreign origin, for they are associated with building-stone which has undoubtedly come by water.

FAGUS SYLVATICA, L.

Neolithic:—

Southampton Docks (Shore and Elwes); Crossness, Essex (wood determined by Marshall Ward); Fenland (A. Bell).

Preglacial (Cromer Forest-bed):—

Happisburgh, Norfolk.

Also recorded from Fahrenkrug, in Holstein, associated with *Brasenia* (Carl Weber); and from Honerdingen, in Hanover, associated with *Juglans* and *Platanus* (Carl Weber).

Salix pentandra, L.

Unknown fossil in Britain.

Recorded from the Pine Zone (Neolithic) in Gotland (Gunnar Andersson); and doubtfully from Grünenthal, in Holstein (Carl Weber).

Salix cinerea, L.

Neolithic (?) :—

Caerwys, Flintshire (in calcareous tufa).

Late Glacial :—

Bovey Tracey (Heer and Nathorst).

Interglacial :—

West Wittering, Sussex.

Preglacial (Cromer Forest-bed) :—

Mundesley (Nathorst).

Also recorded from Fahrenkrug in Holstein (C. Weber); from Klinge bei Cottbus, Prussia (C. Weber); in the Birch, Pine and Oak Zones (Neolithic) in Sweden (Gunnar Andersson).

Salix aurita, L.

Unknown fossil in Britain.

Recorded from Fahrenkrug and Klinge, associated with *Brasenia* (C. Weber); from the Birch, Oak, and Spruce Zones in Sweden (Gunnar Andersson).

Salix Caprea, L.

Neolithic :—

Barry Docks, Glamorgan; Fenland (A. Bell); Caerwys, Flintshire.

Also recorded from Sweden in the Birch, Pine, and Oak Zones (Gunnar Andersson); and from Grünenthal, in Holstein, associated with *Brasenia* (Carl Weber).

Salix phylicifolia, L.

Unknown fossil in Britain.

Recorded from Sweden in the Dryas (Late Glacial), and Birch and Spruce (Neolithic) Zones (Gunnar Andersson).

Salix nigricans, Sm.

Unknown fossil in Britain.

Recorded from Sweden in the Pine, Oak, and Spruce Zones (Gunnar Andersson).

Salix repens, L.

Neolithic :—

Fenland (A. Bell); Barnwell, Cambridge; Cowden Glen, Renfrewshire.

Late Glacial :—

Corstorphine, near Edinburgh; Crianlarich, Perthshire.

Also recorded from Klinge bei Cottbus in Prussia (Carl Weber); and from Lauenburg an der Elbe (Keilhack). In each case it is associated with *Brasenia*.

Salix lanata, L.

Unknown fossil in Britain.

Recorded from the Pine Zone in Norrland (Gunnar Andersson).

Salix Arbuscula, L.

Unknown fossil in Britain.

Recorded from Sweden in the Birch and Spruce Zones

(Gunnar Andersson); and with doubt from Deuben, in Saxony (A. G. Nathorst).

SALIX MYRSINITES, L.

Late Glacial :—

Hoxne, Suffolk (bed C).

SALIX HERBACEA, L.

Late Glacial :—

Hoxne, Suffolk (bed C); Ballaugh, Isle of Man; Kirk Michael, Isle of Man; Hailes, near Edinburgh (lower bed); Corstorphine, near Edinburgh; Gayfield, Edinburgh; Dronachy, Fife; Crianlarich, Perthshire.

Interglacial :—

Faskine, Lanark.

Also recorded from Deuben in Saxony (A. G. Nathorst) and from various localities further north.

SALIX POLARIS, Wahlb.

Late Glacial :—

Hoxne, Suffolk (bed C); Hailes, near Edinburgh (lower bed); Gayfield, Edinburgh; Corstorphine, Edinburgh; Dronachy, Fife.

Early Glacial :—

Beeston, Mundesley, Ostend (in Norfolk).

SALIX RETICULATA, L.

Late Glacial :—

Hailes, near Edinburgh (lower bed); Gayfield, Edinburgh; Corstorphine, Edinburgh; Dronachy, Fife; Crianlarich, Perthshire.

POPULUS CANESCENS, Sm.

Interglacial :—

Grays, Essex ; some leaves collected by Prestwich suggest this species, though they may belong to *P. tremula*, The specimens have suffered from long keeping.

POPULUS TREMULA, L.

Neolithic :—

Caerwys, Flintshire, in calcareous tufa.

Recorded from Klinge bei Cottbus, in Prussia (Carl Weber); from Honerdingen, in Hanover (Carl Weber); also from the Birch, Pine, Oak, and Spruce Zones in Sweden (Gunnar Andersson).

EMPETRUM NIGRUM, L.

Neolithic :—

Close y Garey, Isle of Man (beds B and C).

Late Glacial :—

Hailes, near Edinburgh (lower bed) ; Dronachy, Fife ; Corstorphine, near Edinburgh (lower bed); Crianlarich Perthshire ; Ballaugh, Isle of Man.

Interglacial :—

Airdrie, Lanark.

Also recorded from Honerdingen, in Hanover, associated with *Platanus, Juglans*, *Najas*, &c. (Carl Weber).

CERATOPHYLLUM DEMERSUM, L.

Neolithic (?) :—

Casewick, Lincolnshire.

Late Glacial :—

Hoxne, Suffolk (bed C).

Interglacial :—

West Wittering, Sussex; Admiralty Offices, London (Abbott); Hitchin, Hertfordshire; Southelmham, Suffolk; Hoxne, Suffolk (beds D and E); Mundesley, Norfolk (old valley deposit).

Early Glacial :—

Beeston, Norfolk (base of Arctic Freshwater bed).

Preglacial (Cromer Forest-bed) :—

Common at nearly all localities.

JUNIPERUS COMMUNIS, L.

Unknown fossil in Britain.

Recorded from the Dryas, Birch, Pine, Oak, and Spruce Zones in Sweden (Gunnar Andersson); also from Honerdingen, in Hanover, associated with *Platanus*, *Juglans*, &c. (Carl Weber); and from Grünenthal, in Holstein, associated with *Brasenia* (Carl Weber).

TAXUS BACCATA, L.

Neolithic :—

Common in peat below the sea-level in the Thames Valley and Fenland; Portobello, near Edinburgh.

Interglacial :—

Hoxne, Suffolk (bed D).

Preglacial (Cromer Forest-bed) :—

Mundesley, Bacton, Happisburgh (in Norfolk); Pakefield (in Suffolk).

PICEA EXCELSA, Link.

Preglacial (Cromer Forest-bed) :—

Cromer, Mundesley, Bacton, Happisburgh, in Norfolk.

Unknown in Britain in later deposits. Recorded from the Spruce Zone (Neolithic) in Sweden (Gunnar Andersson); and from Fahrenkrug, and Grünenthal in Holstein (Carl Weber); from Klinge bei Cottbus, Prussia (Carl Weber); and from Honerdingen, in Hanover, associated with *Platanus*, *Juglans*, &c. (Carl Weber).

Pinus montana, Mill.

Preglacial (Cromer Forest-bed) :—

Determined by Heer and figured by Saporta from the Cromer Forest-bed, but I can find no specimens belonging to this species. Small cones of *P. sylvestris* may have been mistaken for *P. montana*.

Pinus sylvestris, L.

Neolithic :—

In 'submerged forests' and at the base of peat-mosses nearly throughout Britain and in Ireland.

Late Glacial :—

Bovey Tracey, Devon (Heer); Hoxne, Suffolk (bed C) (?).

Preglacial (Cromer Forest-bed) :—

Common at various localities in Norfolk, especially Cromer and Happisburgh.

The distribution in space and time of the Scotch Pine is very peculiar. Abundant in the Preglacial Strata of Norfolk, it has not been found in any of the Interglacial Deposits in Britain, though occurring at Fahrenkrug and Grünenthal in Holstein. In Late Glacial times it reappears at Bovey Tracey, in Devon, and perhaps at Hoxne, in Suffolk. During the Neolithic period it seems to have been one of our commonest trees; but afterwards disappeared from the southern half of England; though, when re-introduced, it flourishes and spreads rapidly from seedlings.

Stratiotes aloides, L.

Interglacial :—

Southelmham, Suffolk.

Preglacial (Cromer Forest-bed) :—

Beeston, Sidestrand (in Norfolk); Corton (in Suffolk).

The fruits described by Nehring, Potonié, and myself as *Paradoxocarpus* (or *Folliculites*) *carinatus* have since been shown to belong to *Stratiotes aloides.* They occur abundantly at Klinge bei Cottbus, in Prussia, and at Fahrenkrug in Holstein.

Iris Pseudacorus, L.

Neolithic :—

Crossness, Essex (upper peat); Elie, Fife.

Sparganium ramosum, Curtis.

Neolithic :—

Barry Docks, Glamorgan; Crossness, Essex (upper and lower peats); Tilbury, Essex; Redhall, near Edinburgh.

Late Glacial :—

Hoxne, Suffolk (bed C); Garvel Park (Clyde Beds) (two very small and doubtful carpels).

Interglacial :—

West Wittering, Sussex; Hitchin, Hertfordshire; Hoxne, Suffolk (beds D and E).

Preglacial (Cromer Forest-bed) :—

Beeston, Norfolk; Pakefield, Suffolk; Corton, Suffolk.

Sparganium simplex, Huds.

Unknown fossil in Britain.

Recorded from Honerdingen, in Hanover (Carl Weber).

Sparganium minimum, Fr.

Unknown fossil in Britain.

Recorded from Honerdingen, in Hanover (Carl Weber).

Alisma Plantago, L.

Neolithic :—

Redhall, near Edinburgh; Cowden Glen, Renfrewshire.

Late Glacial :—

Hoxne, Suffolk (bed C).

Interglacial :—

Hoxne, Suffolk (bed D); Southelmham, Suffolk; West Wittering, Sussex; Stone, Hampshire.

Preglacial (Cromer Forest-bed) :—

Beeston, Overstrand, Sidestrand, Mundesley, in Norfolk; Pakefield, in Suffolk.

Sagittaria sagittæfolia, L.

Interglacial :—

West Wittering, Sussex.

Recorded from the Oak Zone in Gotland (Gunnar Andersson).

Scheuchzeria palustris, L.

Unknown fossil in Britain.

Recorded from the Dryas and Oak Zones in Sweden (Gunnar Andersson).

POTAMOGETON NATANS, L.

Neolithic :—

Drope, Glamorgan.

Late Glacial :—

Ballaugh, Isle of Man (bed F).

Interglacial :—

West Wittering, Sussex.

Also recorded from Klinge bei Cottbus, in Prussia; Fahrenkrug in Holstein; Honerdingen, in Hanover (Carl Weber); and from the Birch, Pine, and Oak Zones in Sweden (Gunnar Andersson).

POTAMOGETON RUFESCENS, Schrad.

Late Glacial :—

Twickenham, Middlesex; Hoxne, Suffolk (bed C).

Interglacial :—

Kilmaurs, Ayrshire (?) (Bennett).

Also recorded from Honerdingen, in Hanover, associated with *Platanus*, *Juglans*, &c. (Carl Weber).

POTAMOGETON HETEROPHYLLUS, Schreb.

Neolithic :—

Drope, Glamorgan; Hailes, near Edinburgh.

Interglacial :—

West Wittering, Sussex; Stone, Hampshire; Southelmham, Suffolk; Kilmaurs, Ayrshire (or *P. Zizii*) (Bennett).

Preglacial (Cromer Forest-bed) :—

Abundant at most localities.

POTAMOGETON LUCENS, L.

Neolithic :—

Cowden Glen, Renfrewshire.

Interglacial :—

West Wittering, Sussex.

Preglacial (Cromer Forest-bed) :—

Between Cromer and Runton, in Norfolk; Corton, Pakefield, in Suffolk.

POTAMOGETON PRÆLONGUS, Wulf.

Neolithic :—

Megaceros-marls of Central Ireland.

Preglacial (Cromer Forest-bed) :—

Between Cromer and Runton.

Recorded from the Dryas, Birch, and Pine Zones (Late Glacial and Neolithic) in Sweden (Gunnar Andersson); and with doubt from Honerdingen, in Hanover, with *Juglans*, *Platanus*, &c. (Carl Weber).

POTAMOGETON PERFOLIATUS, L.

Neolithic :—

Redhall, near Edinburgh; Hailes, near Edinburgh; Cowden Glen, Renfrewshire.

Interglacial :—

Southelmham, Suffolk.

Also recorded from Honerdingen, in Hanover, associated with *Juglans*, *Platanus*, &c. (Carl Weber).

POTAMOGETON CRISPUS, L.

Neolithic :—

Gayfield, near Edinburgh; Megaceros-marls of Central Ireland.

Late Glacial :—

Hoxne, Suffolk (bed C); Ballaugh, Isle of Man (bed D).

Interglacial :—

Endsleigh Street, London; Hitchin, Hertfordshire; Southelmham, Suffolk.

Preglacial (Cromer Forest-bed) :—

Beeston, Sidestrand, Trimingham, Mundesley, in Norfolk.

POTOMAGETON DENSUS, L.

Interglacial :—

West Wittering, Sussex.

POTAMOGETON OBTUSIFOLIUS, Mert. & Koch.

Interglacial :—

Endsleigh Street, London; Southelmham, Suffolk.

POTAMOGETON PUSILLUS, L.

Neolithic :—

Hailes, near Edinburgh; Redhall, near Edinburgh; Cowden Glen, Renfrewshire.

Late Glacial :—

Hoxne, Suffolk (bed C).

Interglacial :—

Hoxne, Suffolk (bed D).

POTAMOGETON TRICHOIDES, Cham.

Late Glacial :—

Hoxne, Suffolk (bed C).

Interglacial :—

West Wittering, Sussex; Stone, Hampshire; Southelmham, Suffolk; Hoxne, Suffolk (beds D and E).

Preglacial (Cromer Forest-bed):—

Beeston, Sidestrand, Mundesley, in Norfolk; Pakefield, Corton, in Suffolk.

POTAMOGETON PECTINATUS, L.

Neolithic:—

Cowden Glen, Renfrewshire.

Late Glacial:—

Hoxne, Suffolk (bed C).

Preglacial (Cromer Forest-bed):—

Common at most localities—drupes often very large.

POTAMOGETON FILIFORMIS, Nolte.

Unknown fossil in Britain.

Recorded from Gotland in the Dryas, Birch, and Pine Zones (Gunnar Andersson).

RUPPIA MARITIMA, L.

Interglacial:—

West Wittering, Sussex; Stone, Hampshire.

Recorded from the Pine and Oak Zones in Sweden (Gunnar Andersson).

ZANNICHELLIA PALUSTRIS, L.

Late Glacial:—

Twickenham, Middlesex.

Interglacial:—

Stone, Hampshire; Selsey, Sussex; Endsleigh Street, London; Southelmham, Suffolk; Hoxne, Suffolk (bed E); Kilmaurs, Ayrshire.

Early Glacial :—

Beeston, Norfolk (base of Arctic Freshwater Bed).

Preglacial (Cromer Forest-bed) :—

Abundant nearly everywhere.

ZANNICHELLIA PEDUNCULATA, Reichb.

Interglacial :—

West Wittering, Sussex.

Preglacial (Cromer Forest-bed) :—

Sidestrand, Norfolk ; Pakefield, Suffolk.

At Pakefield a remarkable spinose form of drupelet occurs.

ZOSTERA MARINA, L.

Not certainly known fossil in Britain, though *Zostera*-like foliage occurs in estuarine deposits.

Recorded with doubt by Gunnar Andersson from South Sweden and Gotland.

NAJAS FLEXILIS, Rostkov.

Unknown fossil in Britain.

Recorded from Gotland, and from the *Ancylus*-formation (Pine Zone) in Sweden (Gunnar Andersson); also from Honerdingen, Hanover, and Grünenthal, Holstein, in Interglacial deposits (C. Weber).

This plant in Europe is only known living in the West of Ireland, Scotland, South Sweden, and Gotland.

NAJAS MARINA, L.

Neolithic :—

Barry Docks, Glamorgan.

Interglacial :—

Hitchin, Hertfordshire.

Preglacial (Cromer Forest-bed):—

Beeston, in Norfolk; Pakefield, in Suffolk.

Also recorded from the Pine and Oak Zones of South Sweden and Gotland (Gunnar Andersson); from Klinge bei Cottbus in Prussia, Fahrenkrug in Holstein, and Honerdingen in Hanover (Carl Weber).

NAJAS GRAMINEA, Delile.

Interglacial:—

West Wittering, Sussex.

A widely dispersed Tropical species, which extends into the Mediterranean region, and occurs as an accidental introduction into Britain in a canal which receives waste hot water from a mill. As a fossil it has only been recorded at West Wittering.

NAJAS MINOR, Allione.

Interglacial:—

West Wittering, Sussex.

Preglacial (Cromer Forest-bed):—

Pakefield, Suffolk.

A plant of the Mediterranean region, and of central Europe as far north as the Rhine; it is unknown living in the north or in Britain.

ELEOCHARIS ACICULARIS, Sm.

Roman Period:—

Silchester, Hampshire.

Interglacial:—

Hoxne, Suffolk (bed D); West Wittering, Sussex; Stone, Hampshire.

ELEOCHARIS PALUSTRIS, Br.

Roman Period :—

Silchester, Hampshire.

Neolithic :—

Hailes, near Edinburgh (upper bed); Redhall, near Edinburgh; Megaceros-marls of Central Ireland.

Late Glacial :—

Twickenham, Middlesex; Kirk Michael, Isle of Man; Corstorphine, near Edinburgh; Hailes, near Edinburgh (lower bed); Dronachy, Fife.

Interglacial :—

West Wittering, Sussex; Endsleigh Street, London; Allenton, near Derby.

Early Glacial :—

Beeston, Norfolk (base of the Arctic Freshwater Bed).

Preglacial (Cromer Forest-bed) :—

Pakefield, Suffolk.

SCIRPUS PAUCIFLORUS, Lightf.

Neolithic :—

Hailes, near Edinburgh; Redhall, near Edinburgh; Cowden Glen, Renfrewshire.

Late Glacial :—

Hoxne, Suffolk (bed C); Stair, Ayrshire; Hailes, near Edinburgh (lower bed); Corstorphine, near Edinburgh; Dronachy, Fife.

Interglacial :—

Southelmham, Suffolk; Hoxne, Suffolk (bed D); Allenton, near Derby.

Preglacial (Cromer Forest-bed):—

Beeston and Mundesley, in Norfolk; Corton and Pakefield, in Suffolk.

SCIRPUS CÆSPITOSUS, L.

Interglacial :—

Southelmham, Suffolk.

Preglacial (Cromer Forest-bed):—

Beeston and Mundesley, in Norfolk.

SCIRPUS FLUITANS, L.

Late Glacial :—

Dronachy, Fife (?).

Interglacial :—

Southelmham, Suffolk; Kirmington, Lincolnshire (?); Stone, Hampshire (?).

Preglacial (Cromer Forest-bed) :—

Beeston, Norfolk.

SCIRPUS SETACEUS, L.

Neolithic :—

Hailes, Redhall, and Broughton, near Edinburgh.

Late Glacial :—

Hoxne, Suffolk (bed C).

Interglacial :—

Hoxne, Suffolk (bed D).

SCIRPUS LACUSTRIS, L.

Neolithic :—

Crossness, Essex (lower peat); Casewick, Lincolnshire; Hailes, near Edinburgh; Cowden Glen, Renfrewshire.

Late Glacial :—

Twickenham, Middlesex; Hoxne, Suffolk (bed C); Hailes, near Edinburgh (lower bed); Corstorphine, near Edinburgh.

Interglacial :—

Stone Hampshire; West Wittering, Sussex; Hitchin, Hertfordshire; Hoxne, Suffolk (beds D and E); Southelmham, Suffolk.

Early Glacial :—

Beeston, Norfolk (base of Arctic Freshwater bed).

Preglacial (Cromer Forest-bed) :—

Beeston and Mundesley, in Norfolk; Corton and Pakefield, in Suffolk.

Scirpus maritimus, L.

Neolithic :—

Southampton Docks (?) (a single damaged nut); Barry Docks, Glamorgan.

Scirpus sylvaticus, L.

Unknown fossil in Britain.

Recorded from Vernitsa, St. Petersburg (Gunnar Andersson and Berghell); also from the Pine and Spruce Zones in Sweden (Gunnar Andersson).

Blysmus rufus, Wahlb.

Late Glacial :—

Hoxne, Suffolk (bed C).

Interglacial :—

Hoxne, Suffolk (bed D).

Eriophorum vaginatum, L.

Unknown fossil in Britain.

Recorded from Fahrenkrug, in Holstein (Carl Weber); and from the Pine (?) Oak (?) and Spruce Zones in Sweden (Gunnar Andersson).

Eriophorum angustifolium, Roth.

Interglacial :—

Hoxne, Suffolk (bed D).

Preglacial (Cromer Forest-bed) :—

Between Cromer and Runton, Norfolk; Corton, Suffolk.

Recorded also from the Pine and Oak (?) Zones (Neolithic) in Sweden (Gunnar Andersson).

Cladium Mariscus, Br.

Unknown fossil in Britain, the fruits recorded from the Cromer Forest-bed not belonging to this plant.

Recorded from Klinge bei Cottbus, in Prussia (Carl Weber); and from the Birch (?) Pine, and Oak Zones in Gotland (Gunnar Andersson).

Carex dioica, L.

Neolithic :—

Redhall, near Edinburgh; Hailes, near Edinburgh.

Late Glacial :—

Roxburgh Street, Greenock (Clyde Beds).

Interglacial :—

Endsleigh Street, London; Airdrie, Lanark.

Carex muricata, L.

Interglacial :—

West Wittering, Sussex; Stone, Hampshire.

Carex echinata, Murr.

Neolithic :—

Hailes, near Edinburgh; Redhall, near Edinburgh.

Also recorded from Fahrenkrug, in Holstein (Carl Weber).

Carex remota, L.

Preglacial (Cromer Forest-bed) :—

Pakefield, Suffolk.

Carex alpina, Sw.

Late Glacial :—

Kirk Michael, Isle of Man (determined by C. B. Clarke).

Carex canescens, L.

Neolithic :—

Hailes, near Edinburgh; Redhall, near Edinburgh.

Carex panicea, L.

Neolithic :—

Redhall, near Edinburgh.

Late Glacial :—

Twickenham, Middlesex.

Interglacial :—

Airdrie, Lanark.

Carex distans, L.

Interglacial :—

West Wittering, Sussex; Hoxne, Suffolk (bed D) (?).

Carex flava, L.

Neolithic:—

Hailes, near Edinburgh; Redhall, near Edinburgh.

Carex filiformis, L.

Unknown fossil in Britain.

Recorded from Vernitsa, St. Petersburg (Gunnar Andersson and Berghell); also from the Birch, Pine, Oak, and Spruce Zones in Sweden (Gunnar Andersson).

Carex Pseudo-cyperus, L.

Unknown fossil in Britain.

Recorded from Lauenberg an der Elbe (Carl Weber); and from the Pine, Oak, and Spruce Zones in Sweden Gunnar Andersson).

Carex paludosa, Good.

Preglacial (Cromer Forest-bed):—

Pakefield, Suffolk.

Carex riparia, Curtis.

Interglacial:—

Stone, Hampshire; West Wittering, Sussex; Southelmham, Suffolk.

Preglacial (Cromer Forest-bed):—

Overstrand, Mundesley (?) in Norfolk; Pakefield, in Suffolk.

Also recorded from the Pine (?) and Oak Zones in South Sweden (Gunnar Andersson).

CAREX ROSTRATA, Stokes.

Neolithic :—

Cowden Glen, Renfrewshire.

Interglacial :—

West Wittering, Sussex; Stone, Hampshire; Southelmham, Suffolk; Hoxne, Suffolk (bed D) (?); Airdrie, Lanark.

CAREX VESICARIA, L.

Unknown fossil in Britain.

Recorded from the Pine and Oak Zones in Sweden (Gunnar Andersson).

PHRAGMITES COMMUNIS, Trin.

Neolithic :—

Thames Valley (common); Barry Docks, Glamorgan; Kelsey Hill, Yorkshire.

Interglacial :—

Stone, Hants; West Wittering, Sussex; Kirmington, Lincolnshire.

Preglacial (Cromer Forest-bed) :—

Common nearly everywhere.

Stems, leaves, or nodes of grass are common at most localities; but the only species in a determinable state appears to be *Phragmites communis. Anthroxanthum odoratum*, *Holus lanatus*, *Poa trivialis*, and *Hordeum distichum* have all been recorded; but in each case I think that the specimens are recent and do not belong to the deposit in which they are said to occur. Extreme care is needed to prevent the introduction of grass-seeds, which are dispersed by the wind and adhere to the surface of the clays containing the fossil plants.

Pteris aquilina, L.

Though often stated to occur in a fossil state I have seen no undoubted specimens in Britain.

Recorded from South Sweden (Gunnar Andersson).

Athyrium Filix-fœmina, Roth.

Unknown fossil in Britain.

Recorded from the Oak Zone in Gotland (Gunnar Andersson).

Scolopendrium vulgare, Sm.

Found in calcareous tufa of doubtful age at Dursley, in Gloucestershire.

Lastræa Thelypteris, Presl.

Unknown fossil in Britain.

Recorded from the Oak and Spruce Zones in South Sweden (Gunnar Andersson); and from Klinge bei Cottbus, in Prussia (Carl Weber).

Osmunda regalis, L.

Neolithic :—

'Submerged forests' near Liverpool.

Preglacial (Cromer Forest-bed) :—

Common at Mundesley, Norfolk ; rare elsewhere.

Equisetum palustre, L.

Unknown fossil in Britain.

Recorded from Honerdingen, in Hanover (Carl Weber).

EQUISETUM LIMOSUM, Sm.

Though fragments possibly belonging to this species are not uncommon in peaty deposits in Britain, I have seen no determinable specimens.

Recorded from Lauenburg an der Elbe (Keilhack).

EQUISETUM HYEMALE, L.

Unknown fossil in Britain.

Recorded from the Pine Zone in Norrland, in Sweden, in calcareous tufa (Nathorst); and from Gotland (Gunnar Andersson).

ISOETES LACUSTRIS, L.

Neolithic :—

Hailes, near Edinburgh; Cowden Glen, Renfrewshire.

Late Glacial :—

Garvel Park (Clyde Beds), (J. B. Balfour); Hailes, near Edinburgh (lower beds); Gayfield, Edinburgh.

Interglacial :—

Allenton, near Derby; Kilmaurs, Ayrshire; Faskine, Lanark; Airdrie, Lanark.

Early Glacial :—

Beeston, Norfolk (base of Arctic Fresh-water-bed).

Preglacial (Cromer Forest-bed) :—

Beeston, Norfolk (a single specimen, perhaps from the Early Glacial bed above, which here rests immediately on the Cromer Forest-bed).

APPENDIX.

Table showing the Range in Time of the British Flora.

E = England.	*D* = Denmark.	The foreign range is only recorded where the species is unknown in the equivalent deposits in Britain.
W = Wales.	*F* = Finland.	
S = Scotland.	*G* = North Germany.	
M = Isle of Man.	*N* = Norway.	
I = Ireland.	*S* = Sweden.	

	Preglacial.	Early Glacial.	Interglacial.	Late Glacial.	Neolithic.	Roman.
Clematis Vitalba, *L.*	...	...	E ?			
Thalictrum minus, *L.*	...	E	...	S		
——— flavum, *L.*	E	...	E	...	*S*	E
Ranunculus aquatilis, *L.*	E	E	E S	E S M	E S I	
——— hederaceus, *L.*	?	...	E			
——— sceleratus, *L.*	E	...	E	E	E	
——— Flammula, *L.*	...	...	E	M	S M	E
——— Lingua, *L.*	...	...	E	...	S	E
——— repens, *L.*	E	...	E	E S M	E S	E
——— bulbosus, *L.*	...	...	E			
——— Sardous, *Crantz.*	...	...	E	...	...	E
——— parviflorus, *L.*	...	...	E			
Caltha palustris, *L.*	E	...	E	E	S	E
Nuphar luteum, *L.*	E	...	E	...	E	
Nymphæa alba, *L.*	...	...	E	...	E ?	
Papaver somniferum, *L.*	...	...	...	...	S ?	
——— Argemone, *L.*	...	...	...	...	...	E
Chelidonium majus, *L.*	...	...	E			
Fumaria officinalis, *L.*	...	...	...	...	S ?	
Thlaspi arvense, *L.*	...	...	...	...	...	E
Cakile maritima, *Scop.*	...	...	...	...	*S*	
Viola palustris, *L.*	E	...	E S	E S M	W S	

	Preglacial.	Early Glacial.	Interglacial.	Late Glacial.	Neolithic.	Roman.
Silene maritima, *With.*	...	...	E			
Lychnis alba, *Mill.*	...	...	...	...	S ?	
——— diurna, *Sibth.*...............	...	...	E	S	S	
——— Flos-cuculi, *L.*	...	...	E	S	S	E
Stellaria aquatica, *Scop.*	E	...	E			
——— media, *Cyr.*	E	...	E	E S	S	E
——— Holostea, *L.*	...	...	E			
——— graminea, *L.*	...	...	...	...	...	E
——— uliginosa, *L.*	...	...	...	...	S ?	
Arenaria trinervia, *L.*	...	...	*G*			
——— peploides, *L.*	...	...	E			
Spergula arvensis, *L.*	...	...	...	...	S ?	
Montia fontana, *L.*	...	...	E	E	S	
Hypericum perforatum, *L.*	...	...	E	...	...	E
———— quadrangulum, *L.* ...	E	...	E	...	S ?	
———— elodes, *L.*	...	...	...	...	S ?	
Tilia platyphyllos, *Scop.*	...	...	*G*			
—— europæa, *L.*	...	...	*G*	...	*S*	
Linum, *sp.*	...	...	...	...	S ?	E
Geranium columbinum, *L.*	...	...	*G*			
Oxalis Acetosella, *L.*	...	...	...	S	E S	
Ilex Aquifolium, *L.*	...	...	E	...	E	
Rhamnus Frangula, *L.*	...	...	E	...	*S*	
Vitis vinifera, *L.*	...	...	E ?			
Acer campestre, *L.*	E	...	*G*	...	E	
—— monspessulanum, *L.*	...	...	E			
Prunus spinosa, *L.*	E	...	E	...	E S	
——— domestica, *L.*	...	...	...	...	E	
——— Avium, *L.*	...	...	E	...	E S	
——— Padus, *L.*	...	...	E S	...	E S	
Spiræa Ulmaria, *L.*	E	...	E	...	S	E

	Preglacial.	Early Glacial.	Interglacial.	Late Glacial.	Neolithic.	Roman.
Rubus Idæus, *L.*	...	E	E	E S	E S	
——— fruticosus, *L.*	E	...	E	...	E S	E
——— cæsius, *L.*	...	...	...	...	*S*	
——— saxatilis, *L.*	...	...	...	...	*S*	
Dryas octopetala, *L.*	...	...	...	S		
Potentilla Tormentilla, *Neck.*	...	...	E	S ?	S M	E
——— Comarum, *Nestl.*	...	...	S	M	S	
Alchemilla arvensis, *Lam.*	...	...	E	...	S ?	E
Poterium officinale, *Hook.*	E	E	E	E S M	S	
Rosa	...	...	E	...	E S	
Pyrus torminalis, *Ehrh.*	...	...	E			
——— Aria, *Sm.*	E					
——— Aucuparia, *Gaert.*	...	...	...	...	W	
——— communis, *L.*	...	...	...	...	E	
Cratægus Oxyacantha, *L.*	E	...	E	...	E W S	
Saxifraga oppositifolia, *L.*	...	...	...	*G*		
——— Hirculus, *L.*	...	...	...	*G*		
——— aizoides, *L.*	...	...	...	*G*		
Hippuris vulgaris, *L.*	E	E	E S	E S M	E W S	
Myriophyllum spicatum, *L.*	E	E ?	E S	E S M	S I	
——— alternifolium, *L.*	...	...	...	...	*S*	
Trapa natans, *L.*	E	...	*G*	...	*F S*	
Hydrocotyle vulgaris, *L.*	E	...	E	...	S M	
Apium graveolens, *L.*	...	...	E			
——— nodiflorum, *Reich.*	...	...	E S			
Cicuta virosa, *L.*	...	...	...	...	*S*	
Sium latifolium, *L.*	...	...	...	...	*S*	
Conopodium denudatum, *Koch.*	...	...	...	...	...	E
Chærophyllum temulum, *L.*	...	...	E			
Anthriscus sylvestris, *Hoffm.*	...	...	E			
Œnanthe fistulosa, *L.*	...	...	E			

	Preglacial.	Early Glacial.	Interglacial.	Late Glacial.	Neolithic.	Roman.
Œnanthe Lachenalii, *Gmel.*	E	...	...	S		
——— Phellandrium, *Lam.* ...	E	...	E	E	E	
Æthusa Cynapium, *L.*	...	...	...	...	S ?	E
Angelica sylvestris, *L.*	...	...	E	...	*S*	
Peucedanum palustre, *Mœnch.* ...	...	...	...	...	*S*	
Heracleum Sphondylium, *L.*	E	...	...	E		
Caucalis nodosa, *Scop.*	...	...	E			
Hedera Helix, *L.*	...	...	E	...	E W	
Cornus suecica, *L.*	...	...	...	*S*		
——— sanguinea, *L.*	E	...	E	...	E W	
Sambucus nigra, *L.*	...	...	E	E	E S	E
Viburnum Opulus, *L.*	...	...	E	...	E	
——— Lantana, *L.*	...	...	E			
Galium boreale, *L.*	...	E ?				
——— palustre, *L.*	...	...	*G ?*	...	S ?	
——— uliginosum, *L.*	...	...	*G*			
——— Aparine, *L.*	...	...	...	...	E ?	
Valeriana officinalis, *L.*	...	...	E	...	W S	
Valerianella olitoria, *Mœnch.* ...	...	...	E			
Scabiosa succisa, *L.*	...	...	E			
Eupatorium cannabinum, *L.*	...	...	E	E	E S	
Aster Tripolium, *L.*	...	...	E			
Bidens cernua, *L.*	...	...	...	...	S	
——— tripartita, *L.*	E	...	E	E		
Chrysanthemum segetum, *L.* ...	...	...	...	...	S ?	
——— Leucanthemum, *L.*	...	...	...	...	...	E
Matricaria inodora, *L.*	...	...	...	...	S ?	
Tanacetum vulgare, *L.*	...	E				
Tussilago Farfara, *L.*	...	...	...	...	S ?	
Senecio sylvaticus, *L.*	...	...	...	...	S ?	
——— aquaticus, *Huds.*	...	...	E			

	Preglacial.	Early Glacial.	Interglacial.	Late Glacial.	Neolithic.	Roman.
Carduus crispus, *L.*	...	...	...	...	M	
Cnicus lanceolatus, *Willd.*	E ?	...	E	...	S	
——— palustris, *Willd.*	...	...	E	...	S	
Centaurea Cyanus, *L.*	...	...	...	...	S ?	
Lapsana communis, *L.*	E	...	E	...	S	
Picris hieraciodes, *L.*	E					
Crepis virens, *L.*	...	...	...	...	S	
Hieracium Pilosella, *L.*	...	...	E			
Leontodon autumnalis, *L.*	...	...	E	...	S ?	
Taraxacum officinale, *Web.*	...	...	E	E S	S	
Sonchus arvensis, *L.*	...	...	...	...	S ?	
Vaccinium Oxycoccos, *L.*	...	...	*G*	...	*S*	
——— Vitis-Idæa, *L.*	...	...	...	*G*	*S*	
——— uliginosum, *L.*	...	...	*G*	*S*	*S*	
——— Myrtillus, *L.*	...	...	...	*G*		
Arctostaphylos alpina, *Spreng.*	...	...	...	*S*		
——— Uva-ursi, *Spreng.*	...	...	...	E	*S*	
Andromeda Polifolia, *L.*	...	...	...	S		
Loiseleuria procumbens, *Desv.*	...	...	...	S		
Glaux maritima, *L.*	...	...	E			
Fraxinus excelsior, *L.*	...	...	E	...	E	
Menyanthes trifoliata, *L.*	E	E	E S	E S M	W S	
Myosotis sylvatica, *Hoffm.*	...	...	...	...	*S*	
Solanum Dulcamara, *L.*	E	...	E	...	*S*	
Verbascum Thaspus, *L.*	...	...	E			
Bartsia Odontites, *Huds.*	...	...	...	S		
Pedicularis palustris, *L.*	...	...	...	...	S	
Mentha aquatica, *L.*	E	...	E	...	...	E
Lycopus europæus, *L.*	E	...	E	E	S	
Thymus Serpyllum, *L.*	...	...	...	S		
Prunella vulgaris, *L.*	...	...	...	...	S	E

	Preglacial.	Early Glacial.	Interglacial.	Late Glacial.	Neolithic.	Roman.
Stachys palustris, *L.*	E	...	E	S	S	
——— sylvatica, *L.*	...	...	...	*S*	*S*	
——— arvensis, *L.*	...	...	...	...	...	E
Galeopsis Tetrahit, *L.*	...	...	...	E	S	E
Ajuga reptans, *L.*	...	...	E	E S	S	
Littorella lacustris, *L.*	...	...	...	M	S I	
Atriplex patula, *L.*	E	...	E	S	E S	
Polygonum Aviculare, *L.*	...	...	E	S	S	E
——— Hydropiper, *L.*	...	...	...	...	E	
——— Persicaria, *L.*	E	...	E	E	S	
——— lapathifolium, *L.*	...	...	...	...	S	
——— amphibium, *L.*	...	...	...	...	*S*	
——— viviparum, *L.*	...	...	...	*G S*		
Oxyria digyna, *Hill.*	...	...	...	S		
Rumex conglomeratus, *Murr.*	...	...	E	...	...	E
——— maritimus, *L.*	E	E	E	E		
——— obtusifolius, *L.*	...	...	E	M	S	
——— crispus, *L.*	E	...	E	E S	E W S	
——— Hydrolapathum, *Huds.*	...	...	...	...	*S*	
——— Acetosella, *L.*	E	...	E ?			
Hippophae rhamnoides, *L.*	...	...	...	...	*S*	
Viscum album, *L.*	...	...	...	...	*S*	
Euphorbia Helioscopia, *L.*	...	...	...	...	S ?	
——— amygdaloides, *L.*	E					
Mercurialis perennis, *L.*	...	...	E	...	E S	
Ulmus montana (?) *Sm.*	E	...	E	...	E	
Urtica dioica, *L.*	...	...	E	E ?		
Myrica Gale, *L.*	...	...	*G*	...	*S*	
Betula alba, *L.*	E	...	E	E S	E W S I	
——— nana, *L.*	...	E	E S	E S		
Alnus glutinosa, *L.*	E	E	E	E S	E S	

	Preglacial.	Early Glacial.	Interglacial.	Late Glacial.	Neolithic.	Roman.
Carpinus Betulus, *L.*	E	...	E			
Corylus Avellana, *L.*	E	...	E S	...	E W S	
Quercus Robur, *L.*	E	...	E	...	E W S	
Castanea sativa, *Mill.*	...	...	E ?			
Fagus sylvatica, *L.*	E	...	*G*	...	E	
Salix pentandra, *L.*	...	...	*G ?*	...	*S*	
—— cinerea, *L.*	E	...	E	E	W	
—— aurita, *L.*	...	...	*G*	...	*S*	
—— Caprea, *L.*	...	...	*G*	...	E W	
—— phylicifolia, *L.*	...	...	...	*S*	*S*	
—— nigricans, *Sm.*	...	...	...	...	*S*	
—— repens, *L.*	...	...	*G*	S	E S	
—— lanata, *L.*	...	...	...	...	*S*	
—— Arbuscula, *L.*	...	...	...	*G ?*	*S*	
—— Myrsinites, *L.*	...	...	...	E		
—— herbacea, *L.*	...	...	S	E S M		
—— polaris, *Wahlb.*	...	E	...	E S		
—— reticulata, *L.*	...	...	...	S		
Populus canescens, *Sm.*	...	...	E ?			
——— tremula, *L.*	...	...	*G*	...	W	
Empetrum nigrum, *L.*	...	...	S	S	M	
Ceratophyllum demersum, *L.*	E	E	E	E	E	
Juniperus communis, *L.*	...	...	*G*	*S*	*S*	
Taxus baccata, *L.*	E	...	E	...	E S	
Picea excelsa, *Link.*	E	...	*G*	...	*S*	
Pinus sylvestris, *L.*	E	...	...	E	E S 1	
Stratiotes aloides, *L.*	E	...	E			
Iris Pseudacorus, *L.*	...	...	...	...	E S	
Sparganium ramosum, *Curtis*	E	...	E	E S	E W S	
——— simplex, *Huds.*	...	...	*G*			
——— minimum, *Fr.*	...	...	*G*			

	Preglacial.	Early Glacial.	Interglacial.	Late Glacial.	Neolithic.	Roman.
Alisma Plantago, *L.*	E	...	E	E	S	
Sagittaria sagittifolia, *L.*	...	...	E	...	*S*	
Scheuchzeria palustris, *L.*	...	...	...	*S*	*S*	
Potamogeton natans, *L.*	...	...	E	M	W	
———— rufescens, *Schrad.*	...	...	S ?	E		
———— heterophyllus, *Schreb*	E	...	E S	...	W S	
———— lucens, *L.*	E	...	E	...	S	
———— prælongus, *Wulf.*	E	...	*G*	*S*	I	
———— perfoliatus, *L.*	...	...	E	...	S	
———— crispus, *L.*	E	...	E	E M	S I	
———— densus, *L.*	...	...	E			
———— obtusifolius, *M. & K.*	...	...	E			
———— pusillus, *L.*	...	...	E	E	S	
———— trichoides, *Cham.*	E	...	E	E		
———— pectinatus, *L.*	E	...	...	E	S	
———— filiformis, *Nolte.*	...	...	...	*S*	*S*	
Ruppia maritima, *L.*	...	...	E	...	*S*	
Zannichellia palustris, *L.*	E	E	E S	E		
———— pedunculata, *Reichb.*	E	...	E			
Zostera marina, *L.*	...	...	...	...	*S ?*	
Najas flexilis, *Rostkov.*	...	...	*G*	...	*S*	
—— marina, *L.*	E	...	E	...	W	
—— graminea, *Delile.*	...	...	E			
—— minor, *Allione*	E	...	E			
Eleocharis acicularis, *Sm.*	...	...	E	...	...	E
———— palustris, *Br.*	E	E	E	E S M	S I	E
Scirpus pauciflorus, *Lightf.*	E	...	E	E S	S	
——— cæspitosus, *L.*	E	...	E			
——— fluitans, *L.*	E	...	E	S ?		
——— setaceus, *L.*	...	...	E	E	S	
——— lacustris, *L.*	E	E	E	E S	E S	

	Preglacial.	Early Glacial.	Interglacial.	Late Glacial.	Neolithic.	Roman.
Scirpus maritimus, *L.*	...	...	...	...	E ? W	
——— sylvaticus, *L.*	...	...	...	...	*S*	
Blysmus rufus, *Schrad.*	...	...	E	E		
Eriophorum vaginatum, *L.*	...	...	*G*	...	*S*	
——— angustifolium, *Roth.*	E	...	E	...	*S*	
Cladium Mariscus, *Br.*	...	...	*G*	...	*S*	
Carex dioica, *L.*	...	...	E S	S	S	
—— muricata, *L.*	...	...	E			
—— echinata, *Murr.*	...	...	*G*	...	S	
—— remota, *L.*	E					
—— alpina, *Sw.*	...	...	...	M		
—— canescens, *L.*	...	...	...	...	S	
—— panicea, *L.*	...	...	S	E	S	
—— distans, *L.*	...	...	E			
—— flava, *L.*	...	...	...	...	S	
—— filiformis, *L.*	...	...	...	...	*S*	
—— Pseudo-cyperus, *L.*	...	...	*G*	...	*S*	
—— paludosa, *Good.*	E					
—— riparia, *Curtis*	E	...	E	...	*S*	
—— rostrata, *Stokes*	...	...	E S	...	S	
—— vesicaria, *L.*	...	...	...	...	*S*	
Phragmites communis, *Trin.*	E	...	E	...	E W	
Pteris aquilina, *L.*	...	...	...	...	*S*	
Athyrium Filix-fœmina, *Roth.*	...	...	...	...	*S*	
Scolopendrium vulgare, *Sm.*	...	...	...	...	E ?	
Lastræa Thelypteris, *Presl.*	...	...	*G*	...	*S*	
Osmunda regalis, *L.*	E	...	...	...	E	
Equisetum palustre, *L.*	...	...	*G*			
——— limosum, *L.*	...	...	*G*			
——— hyemale, *L.*	...	...	...	...	*S*	
Isoetes lacustris, *L.*	E ?	E	E S	S	S	

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