Origins and history of the Teesdale flora

Margaret E Bradshaw and Judith Turner

Botanists know the remarkable collection of plants of outstanding scientific interest, referred to in the last chapter, as the 'Teesdale Assemblage'.

The first record to be published was of shrubby cinquefoil (*Potentilla fruticosa*) by John Ray in 1677. This plant had almost certainly been shown to him on the south bank of the River Tees below Thorpe and Egglestone Abbey by Ralph Johnson (1629-95), naturalist and Vicar of Brignall. Studies by Horsman (1995) also show that Johnson knew the wild and remote parts of the upper Dale. In addition to shrubby cinquefoil, he had found northern bedstraw (*Galium boreale*), alpine bistort (*Persicaria bistorta*), native rosebay willow-herb (*Chamerian angustifolium*), spring sandwort (*Minuartia verna*), starry, mossy and hairy saxifrage (*Saxifraga stellaris*, *S hypnoides*, *S. villosum*), Jacob's ladder (*Polemonium caeruleum*), alpine bartsia (*Bartsia alpina*), Scottish asphodel (*Tofieldia pusillum*), dwarf birch (Betula nana) and others. Unfortunately, these records were not made public at the time and much of this knowledge appears to have been lost.

Five botanists in Upper Teesdale
© Janet Rawlins

At the end of the eighteenth century, William Oliver, a surgeon trained in Scotland with a knowledge of the Scottish mountain flora, arrived in Teesdale. Working alone or aided by Binks (a lead miner/and 'simpler'), he made many discoveries or re-discoveries of the Teesdale flora. Fortunately, his association with Harriman was the first step that ensured his discoveries reached the learned members of the Linnean Society of London. The second edition of 'A tour of Teesdale' (Garland 1813) contained a list of over 15 plants, 'which had been supplied by Mr Oliver, a local surgeon'. By the early part of the eighteenth century more species had been found, including spring gentian (*Gentiana verna*), mountain avens (*Dryas octopetala*), Teesdale (rock) violet (*Viola rupestris*), bog stitchwort (*Minuartia stricta*), bog orchid (*Hammarbya paludosa*) and bearberry (*Arctostaphylos alpinus*).

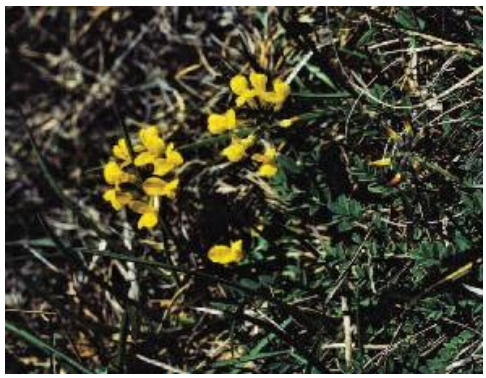
The headstone of William Oliver in Middleton-in-Teesdale Churchyard. © Margaret E Bradshaw

Mountains avens
© Geoff Herbert

In his flora, Baines (1840) included these and other members of the 'Assemblage' and a dense paragraph on plants on the Durham side of the Tees. One famous botanist, visiting Teesdale in 1842, recorded Scottish *asphodel*, hoary rock-rose (*Helianthemum canum ssp. laevigatum*), alpine bartsia, false sedge (*Kobresia simpliciuscula*) and 'several others' – what were these, apparently too well known by those energetic plant hunters that they were not worth listing in his diary? By 1863 Baker, in his Flora, lists at least 22 of the so-called 'Teesdale Assemblage'. Further additions were made so that, almost one hundred years later Pigott (1956) gave some 70 flowering plants and as many lower plants of special phytogeographical interest. Surprisingly, the thrill of discovery in this well-worked area still exists, for in recent years new species have been added, species thought to be extinct have been re-found and other very local plants found in new places.

Many of the species are widely distributed in the arctic and the high mountains of the northern hemisphere, and these belong to the arctic-alpine element, eg. Lady's mantle (*Alchemilla glomerulans*), alpine bartisia, hair sedge (*Carex capillarum*), hoary whitlow grass (*Draba incana*), spring sandwort, alpine bistort, yellow saxifrage (*Saxifraga aizoides*) and alpine meadow- rue (*Thalictrum alpinum*); the arctic-sub-arctic element is represented by alpine foxtail (*Alopecurus alpinus*) (arctic foxtail would be more appropriate!) and another Lady's mantle (*Alchemilla wichurae*); some have their main distribution in the mountains of central Europe and so are the alpine element: spring gentian, mossy saxifrage and alpine pennywort (*Noccaea caerulescens*); a northern montane element contains wood crane's-bill (*Geranium sylvaticum*), bird's eye primrose (*Primula farinosa*) and globeflower (*Trollius europeus*); others with a continental northern type of distribution in Europe are melancholy thistle (*Cirsium heterophyllum*), early spring sedge (*Carex ericetorum*) and Teesdale (rock) violet; more unexpected and significant are the continental southern species: hoary rockrose (*Helianthemum canum spp. laevigatum*) and horseshoe vetch (*Hippocrepis comosa*). Nowhere else in Britain do these species grow together. This is the real significance of the Teesdale Assemblage — relics of the Late-glacial/early Boreal periods 10/8,000 BC.

Arctic-Alpine mountain avens, juxtaposed with southern species early spring sedge and small scabious on Cronkley Fell in 2017
© Margaret E Bradshaw



Horseshoe vetch © Margaret E Bradshaw

The specialness of the interest created by this unusual convergence of so many geographical elements is appreciated when they are considered in the context of the surrounding vegetation which is characterised by such typically west European species as heather or ling, cross-leaved heather, bog asphodel, heath rush and cotton-grass.

The high proportion of arctic-alpine species in the Teesdale flora, the severe climatic features and the significant correlation between some at least of the rare plants and the peculiar metamorphosed 'sugar limestone' led to much speculation on the origin of the assemblage, culminating in the famous discussion at the Royal Society in 1935 (Royal Society, 1935).

Today, it is generally agreed that the majority of the 'Teesdale assemblage of plants' are relics, which were widespread in much of Britain in the Late-glacial period and subsequent warmer periods. Fragmentation of their, then, more or less continuous distribution patterns took place during the subsequent warmer (forest) and later wetter (blanket-bog) periods.

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A further special feature of interest exhibited by several of the rarities is that taxonomically they are represented in Teesdale by local races. In some cases, the divergence from other populations of the same species is sufficiently great to warrant their reclassification as a new sub-species. This is so in hoary rockrose, where the Teesdale population is *Helianthemum ssp. laevigatum* (Proctor 1956). Similarly, a Teesdale sub-species of the bitter milkwort (*Polygala amarella*) has been described by Fearn (1971). This species was nearly eliminated from Teesdale by botanists collecting the largest and most floriferous specimens. The plant is known now to be a short-lived perennial and therefore very dependent on successful seed production and germination to maintain the populations.

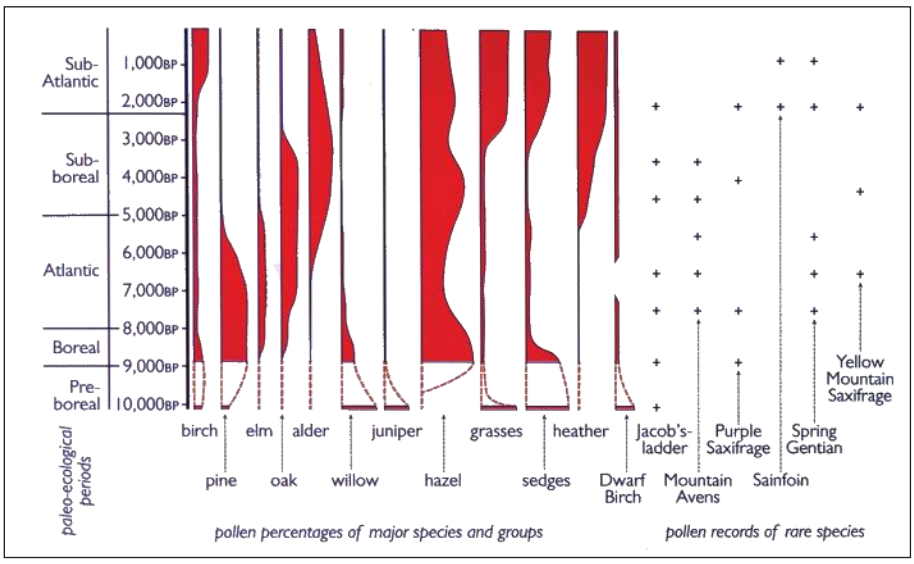
Several species are represented in Teesdale by dwarf or smaller forms: Pigott (1956) points out that some of the Teesdale populations of alpine forget-me-not are much more dwarf than their Ben Lawers counterparts and Elkington (1964) confirms this is genetically controlled; Teesdale mountain avens has very small leaves which are maintained in cultivation; as are the genetic dwarf plants of hoary whitlow grass, *Draba incana var. nana* though these occur in other areas as well as Teesdale. Special studies by Elkington & Woodell (1963) on shrubby cinequefoil again reveal difference in leaf shape between Teesdale and Irish populations and Elkington (1963) also reports differences between the similarly situated populations of spring gentian.

As the Teesdale assemblage of plants exhibits so many special features of interest, it is not surprising that it has excited much interest and speculation as to its origin and history. Wilmot (1930) and Blackburn (1931) suggested that the flora had survived the last main glaciation of Great Britain and perhaps also earlier ones on ice-free areas (*nunataks*) in the Teesdale uplands and whilst some of the species might well have done so, subsequent research work has shown that ten to twelve thousand years ago many of the characteristic Teesdale plants were widespread in the lowlands of England, Ireland and southern Scotland and for that matter in much of central Europe too. The evidence for this comes from the fossil content of deposits laid down during the late-glacial period.

Thus from a late-glacial site at Neasham, near Darlington, Blackburn (1952) identified fossils of mountain avens, hoary rockrose, least willow (*Salix herbacea*) and tea-leaved willow, lesser clubmoss, alpine meadow rue and juniper, all of which, except the willow, occur in Upper Teesdale now and which must in late-glacial times have been constituents of the vegetation of the Darlington lowlands. From a site near London at Nazeing, Allison, Godwin and Warren (1952) identified fossils of shrubby cinquefoil, hoary whitlow grass, mountain avens etc., and pollen of Jacob's ladder and rockrose; while Mitchell (1953) from similar deposits in Ireland has identified seeds of what is probably bog sandwort, now known in Britain only on Widdybank Fell. The position thus is that the fossil remains of practically all the Teesdale rarities have been recovered from late-glacial deposits in this country or on the continent.

Some of this late-glacial flora is thought to have immigrated in late-glacial times from further south on the continent, over the dry bed of the southern North Sea or from refuges around our shores, which are now below sea-level, although some, particularly the hardier species, probably survived the glaciation in sheltered places in the ice-free part of southern Britain or even further north on nunataks. However, wherever they actually survived, it is now well established that the Teesdale rarities were widespread in the lowlands of the British Isles during the late-glacial period and so the interesting question has become, how have they managed to survive the last ten thousand years in Upper Teesdale when elsewhere they died out with the development of the post-glacial forests? We will now consider this question.

There can be no doubt that trees were growing in Upper Teesdale during the post-glacial period as they were elsewhere. This has been demonstrated by pollen- analyses of peat from the area (Johnson and Dunham, 1963, Squires, 1971 and Turner et al., 1973). However, it was no uniform forest (Turner and Hodgson, 1979, 1983, 1991). Even on such exposed summits as Cross Fell there were trees in mid-post glacial times, though not necessarily forming dense woodland (Turner, 1984). On the higher fells hazel and elm were growing more abundantly than in the valley indicating, as these species do, that the soils there were more fertile than they are today. There was also an area with considerable quantities of pine centred on the basin now occupied by the Cow Green Reservoir. And there must have been plenty of other variations but on too small a scale to be detected by pollen analysis.



Composite pollen diagram from Cow Green Reservoir area, by Dr J Turner, from Scott 2017

Whin Sill cliffs open habitat with Rock Whitebeam, Holwick. © Margaret E Bradshaw

This varied woodland was at its most extensive between about seven and eight thousand years ago when peat with its associated plant communities was restricted to a few of the higher cols and to flatter areas just below the ridges where drainage was impeded. Since then blanket peat communities have been replacing woodland more widely, the modern peat profiles often revealing the remains of the earlier trees at or near their base.

The blanket peat spread rapidly between about seven and five thousand years ago during a wetter period, known as the Atlantic, and during the last two and a half millennia several factors have interacted to produce the present landscape. There have been further wet periods together with more demand nationwide for timber, sheep grazing, game-shooting and the practice of agriculture. More recently the peat has begun to erode.

Even before there was any evidence from pollen analysis, Godwin (1949), Pigott (1956) and Pigott and Walters (1954) had suggested that the rare plants had survived in the predominantly wooded and peat- covered landscape because there were always a number of open habitats for them, and initially a larger area of limestone and of base-rich soils would have been available. Today it is even easier to envisage this. Most of the rare species are intolerant of shade, some could have survived in the more open woodland on the fell tops, especially adjacent to the small pockets of peat in the cols, where there would have been plenty of light. Some of the rarities would have been at home along the banks of the Tees and beside the many sikes of the area. Large mammals, like bison, bones of which have been found locally, would have helped to maintain open unstable soils by their trampling and browsing especially around water sources. Drier cliff-ledge habitats too would have been available for some of the rarities throughout the forest period and the developing wet valley and blanket peat communities themselves would have supported others.

There is, however, additional evidence for the survival of the rare species because fossil pollen of a surprisingly large proportion of them has now been found in the peat deposits of Cronkley and Widdybank Fells and others, which are now below the waters of the Cow Green Reservoir. Unfortunately, not every species produces diagnostic pollen. For example, rare spring sedge has pollen which cannot be distinguished from that of other sedges, and spring and bog sandworts both produce pollen indistinguishable from that of several other members of the Caryophyllaceae (pink family). But the following rare plants do produce diagnostic pollen: thrift (*Armeria maritime*), dwarf birch, mountain avens, spring gentian, hoary rockrose, bird's eye primrose, sea plantain, Jacob's ladder, alpine bistort, cloudberry (*Rubus chamaemorus*), least willow (*Salix herbacea*), mountain saxifrage (*Saxifraga aizoides*), starry saxifrage (*Saxifraga stellaris*), Scottish asphodel and chickweed wintergreen (*Trientalis europaea*).

Hoary rockrose

Of these sixteen species, the pollen of eleven, all except bird's eye primrose, least willow), Scottish asphodel and chickweed wintergreen, has been found in deposits dating from the forest period. As the absence of a fossil pollen record does not, of course, necessarily mean that the plant itself was not growing in the area – insect pollinated plants, such as bird's eye primrose, do not shed into the atmosphere much pollen that could become preserved — this evidence confirms beyond any reasonable doubt that the rare plants did survive in Upper Teesdale during the maximum development of woodland and peat bog.

The fossil pollen evidence, interestingly enough, also supports the idea that some of them have been able to expand considerably during the last two thousand years or so as more suitable habitats have become available. Cloudberry, for example, has increased as more blanket peat has developed. Rockrose has expanded with the increase in grassland and so has sea plantain. Jacob's ladder, which was recorded from Teesdale last century, was at its most abundant when the woodland soils were becoming wetter and going over to blanket peat, which is interesting because today it normally grows in tall herbaceous woodland communities where the soil is damp. Fossil pollen of sainfoin (*Onobrychis viciifolia*) has also been recorded. This is not a member of the Teesdale flora today, but it must have been in the past. This is an important addition as the species is a member of the south continental element.

Sphagnum austinii, near Tinkler's Sike, Widdybank Fell

This is good evidence supporting the view that Upper Teesdale has been a refuge for late-glacial plants through the post-glacial period to present times. A few, such as the bog mosses *Sphagnum austinii* and *S. fuscum*, are relics of the wetter Atlantic times, and fortunately have survived the moorland management practices of man. Mysteries remain; in one group (*Alchemilla*) there has been some discussion as to whether the three species of the Continental element (*A. monticola*, *A. acutiloba*, *A. subcrenata*) are early post-glacial relics or have been introduced by early human invaders during the last millennia (Bradshaw, 1962). As diagnostic remains do not exist, evidence of their history may have to be sought through archaeology or folk customs. Lady's mantle was a herb valued by women who may well have taken seed with them when migrating.

Evidence of human occupation in Upper Teesdale since the Late Mesolithic period is provided by chert microliths found on the east shore of Cow Green Reservoir in 2016 close to present day sites of many of the rare species (Young, 2017).

The high incidence of distinct local races in several species can be explained as small-scale evolutionary changes which have taken place during the long isolation of the populations in their Teesdale habitats.

In recent years research has turned to studies of the plant communities. Pigott's first detailed descriptions, published in 1956, have been followed by more detailed investigations of the relationships between the communities and some species and the environmental factors of nutrients, climate, grazing and soil erosion. In addition, studies have been conducted on the population dynamics and reproductive performance of a number of rare species, essential information for determining a management policy for their survival.

A classification of the vegetation of part of the area was completed by Jones in 1973. Using the method of the central European botanists known as phytosociology, Jones found eight classes of vegetation and described several new associations and lesser units, some peculiar to Teesdale. It is of interest to note that the Teesdale rarities tend to occur in the transition zones between the major vegetation classes. Indeed, Jones' work supports the suggestion (Bellamy et al., 1969) that the vegetation in Teesdale, which contains the rare species, constitutes a boundary zone between the arctic/alpine calcareous grasslands of the *Elyno-Seslerietea* and the *Seslerio-Mesobromion*, the upland form of the calcareous semi- dry grassland found in southern Britain and lowland Europe of the class *Festuco-Brometea*. In Europe these classes meet in the central mountains. The Teesdale peculiarities revealed in the wide range of geographical elements can now be seen in the context of widespread vegetation classes of Europe.

No history of Teesdale flora can escape without reference to the effects of the Cow Green reservoir. As predicted, at least twenty-one acres of unique vegetation were destroyed by the flooding and shore erosion is claiming more. Also destroyed were more acres of common vegetation made scientifically more important because of its juxtaposition with the rare forms. Considerable proportions of the Teesdale populations of several rare species were growing in the reservoir basin: 10% of the rock violet, 40% of the early spring sedge, all the tall bog-sedge (*Carex magellanica*) in this part of Teesdale and considerable quantities of many other rarities: spring gentian, false sedge, alpine rush, bird's eye primrose. The greatest loss was of the vegetation mosaics composed of patches of rare and common plant communities. The finest of these was by Slapestone Sike, where south and northwest faces of opposed slopes in a steep-sided valley provided a unique natural outdoor laboratory not repeated anywhere in Teesdale.

Early Spring Sedge

Before inundation the vegetation was described and mapped; herbarium collections were made of the hundred and twenty plants of the reservoir basin for distribution to the major national Herbaria in Europe, Russia and North America; some 15,000 live plants were lifted, most going to centres of research, including two major collections representative of the genetic stock of some twenty species, to be maintained as sources of material at Durham and Manchester Universities, alas both collections have been destroyed. Ironically the opportunity was provided to undertake research, which was itself destructive of the rare communities, before the final flooding.

In spite of these losses, Upper Teesdale is still an exciting place in which to do research.

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