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gius, *Mat. Med.* (ed. 2) p. 679; *Koch*, 134; *Fl. Siles.* iii. 83; *Sven. Bot.* t. 359; *Wahl.* ii. 478; *Sadler, Fl. Pesth.* 351; *Kunth*, ii. 70."

3. *H. maculatum*, Crantz. Stem erect, quadrangular: leaves ovate-elliptical, obtuse, with few pellucid dots: sepals reflexed, ovate-lanceolate, toothed, obtuse, mucronate, with pellucid striæ; petals elliptical, obtuse, with purple striæ and dots beneath. "Crantz, *St. Aust.* (ante 1769), *ed. alt.* 98; *Allioni, Fl. Pedem.* (1785) ii. 45, t. 83, f. 1, (optime). *H. delphinense*, *Villars!* "*Fl. Delph.* (1785) 81;" *Hist. Plant. Dauph.* (1789) iii. 497, t. 44, (male); *Reich!* *Fl. Exsicc.* No. 1500. *H. quadrangulum*, *Leight!* *Shrop.* 370.

XII. *Notes on the Distribution of British Ferns.* By H. C. WATSON, F.L.S.

MR. WATSON commences his admirable remarks by observing that "excepting some spots of small extent, whence they are banished by local peculiarities of the surface, ferns may be said to range over the whole of Britain, from south to north, from east to west, and from the shores of the sea almost to the summits of the loftiest mountains; from which latter situation they are probably absent, rather in consequence of the bleak exposure to wind, than of the diminished temperature incidental to the height of any of our mountains."

The number of species of British ferns will be variously estimated, according to the views entertained by botanists regarding specific limits. "The lowest estimate may be taken at 34; which is raised to 36, by the inclusion of two species now supposed to be extinct, and, perhaps, never found wild in England, namely, *Asplenium fontanum* and *Trichomanes brevisetum*." The latter number will be raised to 40, by those botanists who regard as distinct species the following plants:—*Polypodium Dryopteris* and *calcareum*; *Aspidium lobatum* and *aculeatum*; *Asplenium Ruta-muraria* and *alternifolium*; and *Cistopteris fragilis* and *dentata*. "And the number of 40 would be still farther augmented by the addition of four other varieties, which are sometimes accepted for species, namely,—

- "*Aspidium angulare*, a variety of *A. aculeatum* or *lobatum*."
- "*Aspidium dilatatum*, ... *A. spinulosum*."
- "*Aspidium dumetorum*, ... *A. dilatatum* or *spinulosum*."
- "*Cistopteris angustata*, ... *C. dentata* or *fragilis*."

Then again a few botanists would raise to the rank of species *Aspidium recurvum* and *Asplenium irriguum*; while others would regard as varieties *Cistopteris alpina* and *Woodsia hyperborea*; "but since their views are not shared by many, we may hold our ferns to be estimated at 36, 40, or 44."

The number of species of indigenous flowering plants would in like

manner vary, according to the views of the party by whom the estimate might be made. "By rigidly excluding all species not fully recognised as indigenous, and also numerous varieties which are commonly now counted amongst species, the flowering plants of Britain will be found scarcely to exceed 1200; or, admitting doubtful species, but still excluding doubtful natives, they may be taken at 1400. To reach the number of 1636, given in the Catalogue printed by the Botanical Society of Edinburgh,* we must admit many species of foreign introduction, and a goodly list of varieties named and received as species." But in determining the proportion borne by the ferns to the flowering plants, "if we take a low estimate for one group, we must follow the same rule in the other, or their proportions will unavoidably appear wide of truth." The proportions of the two groups taken from the three estimates of the number of each given above, will be these.

" FERNS.	FLOWERS.	PROPORTIONS.
36	1200	1 to 33 $\frac{1}{2}$
40	1400	1 to 35
44	1636	1 to 37"

The author by way of comparison next gives a table showing the relative numbers of ferns and flowering plants in eight different Floras; the proportions (omitting fractions) being as under.

Iceland	1 to 25	Channel Isles	1 to 51	Sweden	1 to 40
Faroe	1 to 27	Belgium	1 to 67	Lapland	1 to 25
Ireland	1 to 30	Zealand	1 to 47		

"Ferns are thus seen to bear a larger proportion relatively to flowering plants, in the northern and mountainous parts of Western Europe, than is the case with this group of plants in low countries,—such as Belgium, Zealand, and the Channel Isles,—whose latitude nearly corresponds with that of England; whilst the proportions before set down for Britain place it in the scale betwixt Faroe and Iceland, on the one hand, and Belgium and the Channel Islands on the other; the former having a relative predominance of ferns, the latter having a similar predominance of flowering plants."—p. 91.

It is then shown by a comparison of twenty local Floras, that the distribution of ferns in Britain corresponds with their distribution in the north-west of Europe generally, since both the relative and absolute number of species diminish "as we pass from the hilly districts of

*The 1st edition of the Catalogue is here referred to; the number of species (1636) given in the "Enumeration of Plants" prefixed to the Catalogue appears to include the ferns as well as flowering plants. In the 2nd edition the number of species in the two groups is distinctly given as 1594 and 55, (including *Lycopodium*, *Isoetes*, *Pilularia* and *Equisetum*).

Scotland and the north and west of England, towards the low south-eastern countries lying nearest to Belgium." In Yorkshire, according to the table given, there are 36 ferns and 1002 flowering plants; or 1 to 28: the Faversham and East Kent Flora, on the contrary, furnishes only 13 ferns and 806 flowering plants, or 1 to 62: these being the extreme proportions afforded by the twenty Floras examined.—The Midland Flora has 23 ferns and 840 flowering plants, or 1 to 37.

Mr. Watson remarks that "York is pre-eminently the county of ferns;" for although the author of the Yorkshire Flora "has multiplied species more than many other writers on local Botany," the ferns are really most numerous in that county. This the author attributes to various causes, such as its central position, and the diversified character of the country; "the climate of its low vales being sufficiently mild for the growth of species which shun the northern counties of Scotland, without being too warm or dry for the growth of boreal species, to which the hilly districts of its western border are particularly suited, as well as to the production also of the more exclusively mountain species." Then again its coast furnishes *Asplenium marinum*, and its various soils and rocks are adapted for those species which are attached to particular formations.

In Cambridgeshire there are 14 ferns and 847 flowering plants, or the ferns are as 1 to 60. This paucity of ferns is also explained by a reference to the character of the county. A large portion consists of low fens, with but little wood and few hedge-rows; "much of the rest is composed of gentle undulations of chalk," of inconsiderable elevation, with few trees and little water.

"Moray ranks next to Yorkshire in the high proportion of its ferns," (1 to 30). This is accounted for by "the rigid exclusion of introduced species of flowering plants" by the author of the Moray Flora.—On the other hand the number of flowering plants in Northumberland and Durham is high (1030), in consequence of "the addition of many species brought to the coasts of those counties in ship ballast." In the absolute number of species (28) the ferns of these counties rank next to Yorkshire, although, from the cause above mentioned the proportion borne by them to flowering plants is much lower, (1 to 37).

It is evident from the variation in the number of ferns in the several districts, that some species must have a partial range; accordingly it appears that "no one of the district Floras includes all the native species, whilst about half of these Floras include fewer than half of the species." Some species are so widely diffused and so abundant in individuals, that they are probably to be found in every county; others

again are either confined to a few localities, or have a wide range over certain parts of the island although excluded from others.

A table is next given wherein are enumerated forty-three species, showing in how many of the twenty local Floras before mentioned, and in what number of twenty-four manuscript lists, the name of each species occurs. By this means may be gained a tolerably correct idea of the range of our native ferns; although, as the author observes, "without regard to the distinctness of the species, the dates of their first discovery, and the certainty of their nomenclature," erroneous conclusions might be drawn from the list.

Pteris aquilina, *Polypodium vulgare* and *Aspidium Filix-mas* are the only three species "so universally distributed as to be included in all the forty-four district Floras and lists." But although these are our three commonest ferns, yet to neither of them does the widest geographical range in Britain belong. "The most widely ranging of our native ferns, taking into view the three directions of latitude, longitude and elevation, are *Blechnum boreale* and *Aspidium dilatatum* (or *spinulosum*)."

"It has been already stated that ferns prevail chiefly in the hilly tracts towards the north and west, and that they are less numerous in the low south-eastern counties of England,—a peculiarity that is doubtless in great measure attributable to the more humid and cooler atmosphere of the former. The three circumstances on which this difference of climate depends, are those of latitude and longitude, conjointly with elevation of the surface; and the influence of these three conditions in producing the general result, will scarcely admit of divided consideration. We may, indeed, trace some agreement betwixt the range of certain species and the geographical divisions of latitude and longitude; yet this connexion (or, more strictly, this coincidence) is so much interfered with by the third condition, that of height, as to render separate investigation almost useless."—p. 97.

In proof of these positions it is remarked that about half the number of indigenous ferns are absent from the English counties lying to the east of Gloucestershire and Nottinghamshire; "whilst none of the species found growing in these south-eastern counties are wholly wanting in those to the westward of them; most of these species also being much more plentiful in the western counties." The paucity of ferns in the south-eastern counties is accounted for by the different character of the surface, owing to the absence of rocky ravines, waterfalls and mountain elevations, and the consequent dryness of atmosphere, rather than by the difference of longitude.

Nor is the northern or southern limit of a fern's range altogether to be determined by the degree of latitude, though they may be more

decidedly traced than the longitudinal boundaries; yet even in this case the author states the lines of cessation to be determined more by "the hilly and broken character of the surface" than by the degree of latitude; and instances the hills of Wales as bringing "several species into a more southern latitude than it is at all likely they would have been found in, if Wales and the adjacent English counties had been as little diversified with high hills as are the counties under the same latitude on the eastern side of the island."

"The effect of the mountains, however, is probably much more decidedly shown in prolonging the southern range than in arresting the northern range of ferns; since the low coast-line, as well as small plains and valleys around, or amongst the hills, may still afford suitable localities for such ferns as are unfitted to bear the climate of the mountain summits or acclivities, although capable of growing in the climate incidental to the latitude."—p. 98.

The author's classification of ferns according to their range in Britain, and his observations, are very interesting. Those are first given which "may be considered to have a range of latitude almost through the whole of Britain."—

<i>Cistopteris fragilis</i>	<i>Osmunda regalis</i>	<i>Aspidium dilatatum</i>
<i>Polypodium Phegopteris vulgare</i>	<i>Scolopendrium vulgare</i>	<i>Asplenium Filix-femina</i>
<i>Pteris aquilina</i>	<i>Hymenophyllum Wilsoni</i>	<i>Trichomanes</i>
<i>Blechnum boreale</i>	<i>Aspidium lobatum</i>	<i>Ruta-muraria</i>
<i>Botrychium Lunaria</i>	<i>Oreopteris</i>	<i>Adiantum-nigrum</i>
<i>Ophioglossum vulgatum</i>	<i>Filix-mas spinulosum</i>	<i>marinum</i>

Four of the above twenty species "are very rare in the south of England, namely, *Botrychium Lunaria*, *Cistopteris fragilis*, *Hymenophyllum Wilsoni* and *Polypodium Phegopteris*, especially the last; and they are not found at all in the Channel Isles." *Asplenium marinum*, *Scolopendrium vulgare*, *Ophioglossum vulgatum* and *Osmunda regalis*, are decidedly rare in the north of Scotland, "and they are not found at all in the Faroe isles, though the *Ophioglossum* is stated to grow in Iceland."

The following are "boreal and mountain ferns, which are unknown southward of the Thames."—

<i>Woodsia hyperborea</i>	<i>Cistopteris dentata</i>	<i>Asplenium septentrionale</i>
<i>ilvensis</i>	<i>Polypodium Dryopteris</i>	<i>Aspidium Lonchitis</i>
<i>Cistopteris alpina</i>	<i>Asplenium viride</i>	<i>Cryptogramma crispa</i>

Four species are given as being chiefly "confined to the middle latitudes of Britain."—

Eight species, found chiefly in the hilly districts of the north and west, yet occasionally occur "so far from the mountain tracts, that they cannot be held in the character of exclusively mountain ferns."—

Cistopteris alpina	Hymenophyllum Wilsoni	Polypodium calcareum
dentata	Polypodium Phegopteris	Botrychium Lunaria
fragilis	Dryopteris	

It is next remarked that "under the combined influence of latitude and longitude, thus modified by the effect of elevation of surface, the lower limits of many ferns, equally as those of flowering plants, appear on a map like irregular lines, whose general direction runs from south-west to north-east; whilst their upper limits encircle the hills, or the hilly tracts, like zones or belts." It must not, however, be supposed that by terminal lines are to be understood any others than "artificial lines, drawn on a map, so as to connect the extreme stations for any species in either direction." Also the terms *upper* and *lower* limits are to be understood as applying "to latitude, to elevation above the sea-level, and also in some measure to the degree of proximity to the mountain tracts." In the neighbourhood of the latter a great change in the character of the Flora of a district becomes evident, although the latitude and absolute elevation remain nearly the same. Thus the upper limit of British plants will include, unless otherwise qualified, the three conditions of more northern latitude, increased elevation and greater proximity to mountain tracts. Again, by the lower limits are to be understood "the opposite conditions of southern latitude, diminished elevation, and also comparative remoteness from the mountain tracts, as centres around which the species are distributed."

These explanations being kept in view, it will be seen to be impossible at present to represent on maps the distribution of British plants with anything like accuracy, "in consequence of the upper limits of most of the species being yet so little known." Their upper limits in latitude might be traced pretty accurately; and an approximation to their altitude above the sea-level might be arrived at; but the difficulty would be to determine their propinquity to the mountain centres. This can only be ascertained when botanists shall carefully record the places where plants of the plains are last seen by them, as they enter amongst the valleys of the mountain districts.

"As an example of such difficulties, let us take *Scolopendrium vulgare*, a fern widely diffused in Britain from Orkney to the Isle of Wight, and abundant in the south of England. Betwixt these extreme points, however, there are many wide spaces

from which this fern is wholly absent; and one of these spaces perhaps includes nearly the whole of the Highlands. The *Scolopendrium* is reported to grow in the counties of Renfrew, Lanark, Edinburgh, Forfar, Nairn and Orkney, and thus seems partially to encircle the Highlands. But whether its extreme stations, or upper limits towards the mountain centres, are found in these counties, remains to be shown. Again, *Pteris aquilina* is exceedingly plentiful in Britain, from one extremity to the other, but it fails upon the higher hills of Wales, the north of England, and the Scottish Highlands; and may even prove to be wholly absent from a transverse belt of high moors and hills crossing Scotland about the 57th parallel of latitude. But what botanist can trace on a map of Britain those portions of the surface from which this very conspicuous fern is quite absent?—p. 103.

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“In returning from this digression respecting maps to the immediate subject of the present paper, it may be farther observed, that ferns, as a class of plants, cannot be exclusively connected with any particular local situation or quality of soil. For the most part, a shady situation, damp ground and atmosphere, and a porous or peaty soil, are suitable to ferns; whilst exposure to sun, wind, and salt spray, as well as very dry or marshy localities, are unsuitable. But some of the *Asplenias* grow in dry crevices of rocks and walls, as also do *Grammitis Ceterach*, *Polypodium Dryopteris*, and *Polypodium calcareum*, and even the less rigid ferns constituting the genus *Cistopteris*. On the contrary, *Osmunda regalis* might almost be designated a marsh fern; and other species so far approximate to the same character, as to thrive in swampy ground, that is, in watery places, where the soil is loose and spongy; for example, *Aspidium Thelypteris*. But ferns that grow well in swampy places will also grow well on rocks and banks where the soil is not particularly wet; for instance, *Blechnum boreale* and *Asplenium Filix-fœmina*. None are aquatics. One only is a littoral species, *Asplenium marinum*; and this one is occasionally seen in places many miles from the sea. *Osmunda regalis* so frequently occurs near the shore, within reach of the salt spray, and even at times within reach of high tides, that it might be regarded as a sub-littoral species. None perhaps require the sun's rays directly shining upon them; but some few will bear daily exposure to the sun for several hours, though the greater number thrive best on a slender allowance of sunshine. It cannot yet be stated that any species are absolutely limited to soils of a particular chemical or geognostic character; but *Grammitis Ceterach*, *Polypodium calcareum*, and the species of *Cistopteris*, certainly affect lime rocks, though, indeed, it is believed by some botanists, that the *Polypodium calcareum* is a variety of *P. Dryopteris*, varied in its habit through the influence of soil or exposure. If so, the only species that is limited to limestone, if even it be so limited, is *Grammitis Ceterach*. The harder kinds of trap and slate rocks seem favourable to *Asplenium septentrionale* and *Woodsia ilvensis*.—And, in general, the sand-stones are more productive of ferns than chalk or clays; though the difference here is probably owing more to the mechanical than to the chemical qualities of the soils.”—p. 105.

(To be continued).