difference had fallen to 2·7° C. The greatest difference of temperature due to cold air drainage was thus nearly the same as the average apartness between the two laboratories during September. The evidence afforded by this series of readings and by the first autumnal effects of frost on vegetation in narrow cañons, shows that the stream of cold air is always a shallow one, probably never exceeding 18 m. in depth.

The author gives curves to show the fall of temperature with increase of latitude in (1) the ridge stations, (2) the valley stations; the two curves are approximately parallel. A vivid realisation of the importance of cold air drainage in relation to the vertical distribution of plants is obtained by selecting a temperature on the ridge curve and then finding the elevation at which the same temperature occurs on the cañon curve. For instance, the mean minimum on the ridge at 2135 m. is 50·6° C., and on the cañon curve we find this temperature at 1419 m.—that is, the minimum temperature conditions of a ridge at 2135 m. will not be found in a cañon until we have descended to 1419 m., hence a difference of topographic site at the same altitude is the equivalent of 716 m. of difference in altitude between localities of the same topographic situation.

The influence of cold air drainage might be expected to affect both the upward limitation of lowland species and the downward occurrence of montane species. As a matter of fact the downward limitation of the forest and chaparral vegetation of the desert mountain ranges is due to the operation of the factors of soil and atmospheric aridity, and not to the chimenal factors. The limitation of the upward distribution of desert species appears, however, to be attributable to the chimenal factors, as shown by the author for *Carnegeia gigantea* ("The influence of low temperatures on the distribution of the giant cactus," *Plant World*, **14**, 1911, pp. 136–146), and he has observed that several of the most conspicuous desert species range to much higher altitudes on ridges and the higher slopes of cañons than they do in the bottoms and lower slopes of cañons. He has found that there is no essential difference between the soil moisture of ridges and the bottoms of cañons during the driest portions of the year; nor is there any evidence that desert species would fail in the cañon bottoms if they were somewhat higher in soil moisture content. An explanation of the absence of the desert species from cañon bottoms and their occurrence at higher elevations on ridges must be sought in some operation of the chimenal factors rather than in the factors of soil and atmospheric moisture. The author concludes by expressing his belief that an analysis of the operation of the chimenal factors will lead to the discovery that cold air drainage plays an important part in determining not only the lowness of the minimum but also the still more important features of the duration of low temperature conditions.

INFLUENCE OF WIND ON ISLAND FOREST DISTRIBUTION

Rigg, G. B. "Forest distribution in the San Juan Islands: a preliminary note." *Plant World*, **16**, 1913, pp. 177—182.

On the San Juan Islands, situated between the Strait of Juan de Fuca and the Strait of Georgia, about 123° W. and 48° N., there are four conspicuous cases of hills in which the north slope is densely forested while the southern slope is practically destitute of trees; the forest is largely coniferous and is mainly of *Pseudotsuga taxifolia*. Two of these hills stand respectively on the south-eastern (Cattle Point) and eastern (South Hill) extremities of San Juan Island, the largest of the group; the other two are on the much smaller Spieden and Sentinel Islands on the north of the main island. The trees at the summit of Cattle Point show the effect of the strong southerly winds which prevail there, especially during winter; many of the trees on the ridge of the hill have their branches much better developed on the north side than on the south; in some cases branches originating on the south side have their direction reversed and grow toward the north; in other cases even the whole tree is so bent toward the north as to be almost prostrate, the trees thus affected being mainly *Pseudotsuga taxifolia* and *Pinus contorta*—in many of the trees of these species growing near the top of the ridge the tops are dead, while in some cases the whole tree is dead. These facts suggest strongly that the barren condition of the southern slope might be due to the strong southerly wind that prevails there in winter. West of this hill is a ridge so low that both the north and the south slopes are very gentle and

there is no sharp line of division between the two; here both slopes are entirely barren of trees—on the basis of the wind theory this might be explained on the ground that here the wind has a clean sweep across both slopes.

The fact that the soil on those parts of Cattle Point and South Hill where the forest has failed to grow is gravelly suggested that the difference in soil on the two slopes may be the chief cause of the difference in forest distribution, and the author has investigated carefully the character of the soil on the barren and forested portions of the four elevations. In all four cases the soil on the barren portion is black and powdery, containing a good deal of gravel, while the forested portion is everywhere covered with two feet or more of yellow clay containing occasional irregular fragments of rock. The clay layer is largely free from gravel, and at the surface there are a few inches of forest humus; below the clay the character of the soil is much as it is at the surface on the barren portion of the elevation. In one place on the Cattle Point elevation a portion of the northern slope is without trees, and this portion shows the same black gravelly soil as that of the barren southern slopes; the low ridge above referred to was found to have gravelly soil on both slopes.

On South Hill, Spieden Island, and Sentinel Island the trees at the summit show practically no distorting effect of the wind; whatever wind effect takes place is confined to the very tops of the trees and is so slight that it can be detected only on careful scrutiny of individual trees. The bending of trees, apparently as a result of wind, is common throughout San Juan Island, and the bending of the tops of occasional trees on the three elevations referred to seems to be no greater than in other places where the forest flourishes in spite of the influence of wind on the tree tops. On Spieden Island occasional trees are found on the southern slope and even these are practically free from wind effects; many of the trees on the southern slope are *Quercus garryana*, a very few are *Pseudotsuga taxifolia*, and while a good many *Quercus* trees are found on the summit of the ridge, only occasional ones are found in the forest on the northern slope and these only near the summit. The conditions here of a transition from a yellow clay soil producing a fir forest to a gravelly soil producing practically no trees is strikingly similar to the conditions found near Tacoma, Washington, where the forest borders the open gravelly prairie; the fringe of oaks between the forested area and the open prairie occurs in both cases.

From the author's observations it is seen that of the four cases of barren southern slopes and forested northern slopes described, only one shows any conspicuous evidence of the effect of wind, and it seems difficult to accept as the single common cause an influence that shows any considerable effect in only one case. Among subjects worthy of investigation he mentions the extent to which the relative water-holding capacity of the two soils is responsible for the forested condition on the one and the barren condition of the other, as well as the question of their relative fitness for the growth of mycorhiza and micro-organisms which may possibly be determining factors in this forest distribution; and he concludes that while several factors are probably concerned in the question of forest distribution in cases like this, large consideration will have to be given to edaphic factors.

EVAPORATION CONDITIONS AT SKOKIE MARSH, ILLINOIS

Sherff, E. E. "Evaporation conditions at Skokie Marsh." *Plant World*, **16**, 1913, pp. 154—160.

The general ecological conditions at Skokie Marsh have been described by the author (see notice in this JOURNAL, **1**, pp. 112—113). As shown by Livingston in his well-known studies of transpiration, in a general way the measure of transpiration in plants is fairly indicative of their respective environmental conditions; the transpiration rate for most plants being roughly proportional to the rate of evaporation of water from a partially open receptacle, he introduced the porous-cup atmometer for measuring the evaporation rate of water. The author set four atmometers at different stations (A) near the edge of the stream, (B) in the outer part of the reed swamp, (C) in the outer part of the swamp meadow, (D) in a stretch of forest beyond the swamp meadow. No. 1 was in the centre of a dense growth of *Typha angustifolia*—as summer advanced, plants of *Teucrium occidentale* and *Scutellaria galericulata* grew up in the shelter of the *Typha*;