ADVANTAGES OF RIVER CANYONS FOR ECOLOGICAL STUDY

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The dunes of Lake Michigan have long since become classic soil to American botanists. They were early recognized by taxonomists of a former generation as collecting grounds unsurpassable for richness and variety of flora. Under the eye of Cowles (*1*) they became the cradle of ecology upon this continent, and the starting-point of the whole successional idea. Fuller (*2, 3*), a pioneer in the quantitative study of physical factors of the environment, carried on his work here. And latterly Cowles (*4*) again has made them a point of departure in a significant essay in floristic history.

It is only natural that the dunes should have become a great outdoor laboratory of botany. Their relatively great topographical relief, their restless and rapid changes of position and surface, with erosion and deposition going on simultaneously within radii of a few yards, their relations to significant recent geological events, all conspire to bring together in one place a most remarkable diversity of environmental factors, and therefore also a group of plant communities notable alike for their clean-cut character as ecological associations and as floristic groups.

The botanical advantages they offer, their topographical unity and geographical continuity, and the fact that they have furnished the material for so many well-known pieces of research, have rather tended to make the dunes an overshadowing fact in middle-western botany. It is the object of the present paper to bring out the point that they do not present a unique and isolated phenomenon in an otherwise dull and commonplace stretch of country. Rather they are simply outstanding and critical features in an entity much larger than themselves, an entity that has many other features just as critical though less outstanding, which, nevertheless, await and will reward scientific investigation.

I do not need to remind this audience that the dominating event in the history of all the botany of this region, whether floristic or ecological, was the advent of the glaciers. Their advance and retreat, and the postulated climatic fluctuations that have occurred since their final disappearance, were the ultimate causes of the distributional peculiarities of floral disjuncts of northern, Appalachian and southwestern affinities, as well as of the successional relationships of the vegetational communities proper to the region. The glaciers set the problems in this part of the country for students of ecology and field botany in general.

Communities of floral disjuncts, as well as the most clean-cut display of successional series, will always be found where the greatest development of topographical and soil diversities give rise to the most marked modifications in ecological factors. These critical points, these points of profitable attack, therefore, must be sought out and studied not as discrete and unrelated matters of interest, but rather as coordinated parts of a whole. The rocky peninsulas and islands of the Superior region, the morainal lakes of Minnesota and Wisconsin, the dunes of Lake Michigan, and that remarkable series of steep-sided river canyons scattered across the upper Mississippi valley from Ohio to the Dakotas, are all chapters in one great work, and all must be read before any may be fully understood.

It is about the river canyons that I want to speak for a few minutes. In advance I want to say that I do not come to tell about them, for I have only begun to try to find out a little about a single one of them; rather I stand as one just a bit aghast at the size of the task and look about for help. It is emphatically more than a one-man job. What I bring is a challenge and an invitation.

These canyons, as I have said, are scattered across nearly the whole of the upper Mississippi valley. Many of them have more than local repute. Sugar Grove in Ohio, Turkey Run in Indiana, Starved Rock and Apple River in Illinois, the Dells in Wisconsin, Wildcat Glen, the Palisades of the Cedar and Steamboat Rock in Iowa, are familiar enough names to most of us, and there are

plenty of others which, if less well known, are quite as beautiful and striking in their scenery, and quite as interesting in their natural history. In all of them one gets much the same kind of story: a great telescoping of successional series and unusual groups of plants far out of their ordinary range. Each of these places is a "farthest south" in its own region for such northern species as white pine, yew, aspen, Canadian elderberry, harebell and Arctic primrose. Each has outliers of southeastern and southwestern floras. Naturally the eastern forms are more numerous in Ohio and the western forms in Illinois and Iowa, but the significant thing is that in any locality the canyon disjuncts represent a long jump from the nearest open-country community of the same species. Thus, a well-developed stand of sugar maple is a noteworthy feature of the Iowa canyons, while at Sugar Grove, Ohio, where sugar maple is a commonplace, the rhododendron, whose main range is in the southern Alleghenies, becomes a sort of floristic equivalent. There is no point in piling up examples; the character of these canyons as botanical outposts is evident at a glance even to a casual tourist.

The presence of these disjuncts, particularly of the northern ones, becomes very suggestive when the location of the canyons is examined in connection with the line representing the farthest advance of the last (Wisconsin) ice sheet. The accompanying map (fig. 1) shows, in a roughly approximate way, the relation of the half-dozen canyons named in the preceding paragraph to the edge of the Wisconsin drift and also to the driftless "island" in southern Wisconsin and northern Illinois and Iowa. The older drift exposures are omitted for the sake of simplicity; what is shown is sufficient for the purposes of illustration. Moreover, the erosion due to the release of water from this, the latest of the glacial masses, is still fresh, and the sides of the cliffs and canyons are still actively weathering, so that the ecological factors here are more active and more sharply contrasted than they are in parts of the older drift not so immediately affected.

It was on the sides and edges of these canyons that the first hardy tundra vegetation appeared when the last of

the ice melted under the rain-deluges of its own begetting, back in the earliest post-pleistocene, and here one still finds them: conifers and ericads and reindeer-lichens. It was up the rich and sheltered valleys that the plants of a milder climate came, pawpaws and tulip-trees and sassafras, and it is in the valleys that they have held their place. Where the country rock is a sandstone, as at Starved Rock, the newcomers from the southwest, cactus and sagebrush and bunchgrass, gained and kept a foothold where the soil from its decomposition accumulated. And everywhere one can find places where the whole successional series proper to the region, from the burr oak of the prairie edges and the black oak of the dry upland woods, lie only a literal stone's throw from the elm and linden of the floodplain and the willows at the water's edge.

An excellent illustration of such a place is Lovers' Leap cliff at Starved Rock, shown in figure 2. (A Lovers' Leap is another feature that most of these canyons

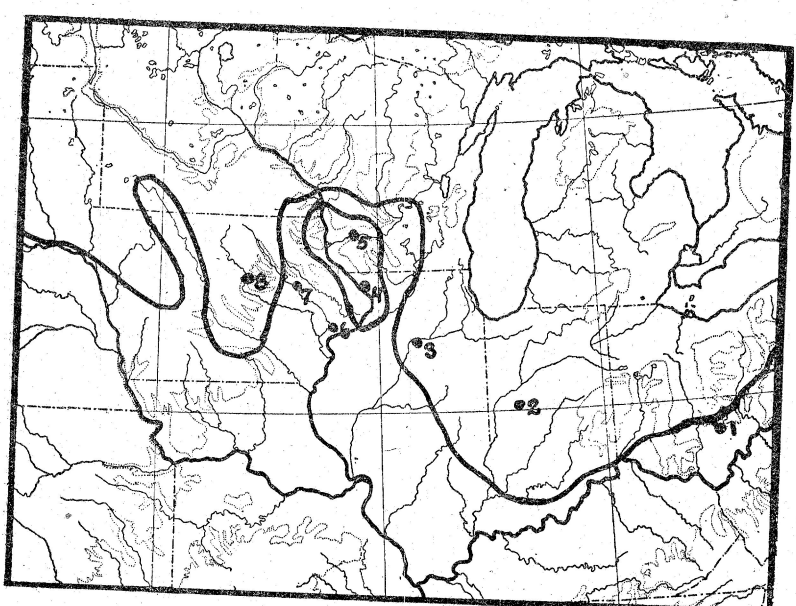

Fig. 1. Map showing distribution of representative river canyons.
1. Sugar Creek region
2. Turkey Run
3. Starved Rock
4. Apple River
5. The Dells of the Wisconsin
6. Wildcat Glen
7. Palisades of the Cedar
8. Steamboat Rock

have in common.) Here on the thin soil of the plateau is an association of black oak, with a few burr oaks about the margin, and bracken fern and xerophytic herbs under the trees. At the edge of the cliff, and along precarious footholds on its sides, where the steep drop toward the river comes, are white pine, arbor vitae and juniper, with mountain holly, shadbush, blue-berry and huckleberry, harebell, wild lily-of-the-valley and polypody. On the inland slopes, where talus has accumulated against the sides, come red and white oaks and witch-hazel, shading magnificent ferneries and beds of mesophytic spring flowers. At the foot, on the river terrace, is a mixed hardwood growth, ranging from white oak and sugar maple through elm, linden and Kentucky coffee tree to soft maple and willow at the water's edge. On an exposed shoulder of the plateau, where weathered sand has gathered, are bunch grasses, euphorbia and xerophytic composites and legumes. And it all lies within a radius of less than two city blocks. Even the dunes cannot equal this.

All this wealth of botanical possibilities is practically untouched. Griggs (*5*) has worked out the botany of the Sugar Grove region pretty thoroughly. Pepoon (*6*) in 1919 presented a plea before this society for the creation of a state park at Apple River. Cowles (*7*) has a brief section on botany in the bulletin of the Chicago Geographic Society on the Starved Rock state park. There are brief statements, mostly mere paragraphs, by various authors on the Iowa canyons in a report of the Iowa State Board of Conservation (*8*). Aside from some popular articles, that is about all there is in print. During the spring and summer of 1921, at the suggestion of Doctor Cowles, I spent a great deal of time at Starved Rock, but what I have to say is still *im werden,* and I do not feel that my data more than scratch the surface.

When it is recalled that there are dozens of such canyons, big and little, each with its own story to tell and none complete until all are complete, do you wonder that I send up a Macedonian cry for help? Here is botanizing, interesting, profitable, worth while as contributory data in the solution of a problem of continental

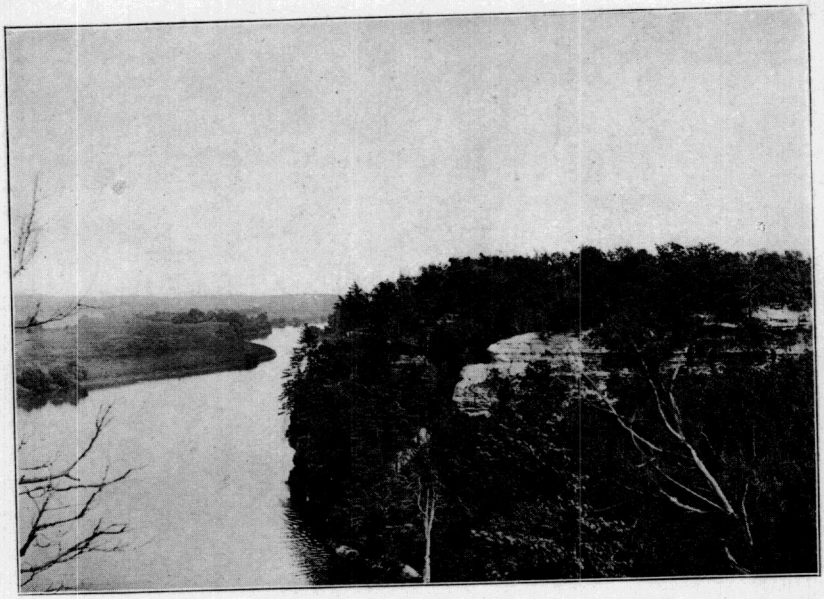

Fig. 2. Lovers' Leap, Starved Rock State Park, Illinois.

Fig. 3. Looking down a side canyon, Starved Rock State Park.

size. Every one of us is within striking distance of some sort of a river canyon, perhaps in our own home county, certainly within week-end flivvering distance. If there is anyone who is casting about for something promising in field botany, I for one, having made proof of the pudding, can assure him that it is most excellent eating.

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