The Frontier of the Carolinian Fauna in the Lower Delaware Valley

BY SPENCER TROTTER

A well-defined rise of land trends along the western side of the lower Delaware Valley in southeastern Pennsylvania. To a casual observer it forms that final ridge of upland country from which one gets an outlook over the flat expanse of the coastal plain. To a geologist it marks the seaward border of an ancient Appalachian land of worn-down crystalline rocks, along the foot of which the Delaware River or some older body of water has spread its flood-plain deposits of gravel, sand, and clay at a comparatively recent period. Where the rivers, flowing down from the Appalachian plateaus, break across this line of demarcation between the older rocks and the recent alluvium, their courses are beset with a series of rapids just before they pass into the deep slow-moving currents of their lower reaches —a feature so characteristic of these streams that it is recognized by geologists as the "fall-line." This fall-line extends for a long distance and marks a very definite and rather abrupt change in the flow of the Delaware and its lower affluents and of the Susquehanna and other Chesapeake rivers. It possesses interest for the historian and the student of political geography from the fact that its lower edge determines the upper limit of navigable waters, at least in the Delaware and the head of Chesapeake Bay, while its "falls" have long been a more or less considerable source of power. These two features have played an important part in the location of a group of cities, extending from New York through Trenton, Philadelphia, Wilmington, Baltimore, Washington, Richmond, Raleigh, Columbia, and Augusta to Macon, affording water-power for the earlier industrial development of the region and, in the case of the

more northern cities, a ship-way to the sea. In southeastern Pennsylvania this "upland terrace" is marked on survey maps by the 200-foot contour. Fox Chase, the escarpment at Wayne Junction, George's Hill in Fairmount Park, Swarthmore College and the Chester Reservoir are some of the well-known points along this overlook. The Baltimore "Pike" follows along the brow of this terrace from Clifton Heights to Swarthmore.

Now this same fall-line has, to the student of animal and plant distribution, another and an exceedingly interesting significance in that it marks, or has long been supposed to mark, in its northern portion, a boundary line between two faunal areas—the Carolinian and the Alleghanian. Two important lines of thought present themselves in considering this faunal frontier. What relation does the distribution of living beings, thus limited in their northward spread, bear to the geological history of the land area in question, and, secondly, does this topographical feature in reality possess the qualities of a barrier?

From all the evidence that exists in its topography and in the nature of its deposits there is little doubt that the present coastal plain was, in comparatively recent times, a submerged landward strip of the continental shelf, the greater portion of which still lies beneath the marginal waters of the Atlantic, stretching eastward for some two hundred and fifty miles from the Upland terrace (fall-line) to the 100-fathom line, where it slopes abruptly down into the deep basin of the ocean. The whole width of this shelf is quite uniform from north to south, but in the northern portion the submerged area is far in excess of the exposed part that now forms a narrow coastal plain. The deposits of this strip of land are of the Tertiary and Quaternary Age, and the uplift probably took place slowly during the late Pliocene and the early Quaternary.

The history of the Carolinian fauna appears to be intimately related to this coastal-plain formation. As the area became an exposed land-surface a gradual spread of forest-growth took place wherever soil-conditions were favorable, the several dominant types of plant-associations occupying districts best suited to their peculiar physiological needs. The more or less uniform

character of this flat lowland, broadening toward the south and extending around the foot of the southern Appalachian Plateau into the bottom lands of the Mississippi and Ohio drainage, induced the spread of a more or less similar type of vegetation throughout its whole extent. In the narrow northern Atlantic portion of this coastal-plain lowland the tree-growth is strikingly like that which prevails farther to the south and in the interior. It is predominantly a hardwood growth of broad-leaved deciduous forms of great variety. This forest, which finds its best expression in the interior lowlands, is intimately related to humid conditions and to soils of alluvial character. Such species as the Sweet Gum (*Liquidambar*), the Swamp Bay (*Magnolia virginiana*), the Pepperbush (*Clethra*), and certain oaks, besides several other forms, are highly characteristic. These broad-leaved trees find the conditions of their growth in meadow soils of a deep loamy character, while in the extensive sandy tracts throughout the coastal-plain area pines are the prevailing woodland, forming the familiar "pine barrens."

Faunal distribution is very closely associated with the spread of certain types of vegetation, and it seems highly probable that the presence of the Carolinian fauna in the lower Delaware Valley is thus an integral part of the coastal-plain forest. As this forest, finding suitable soil conditions, gradually came to occupy the slowly uplifting margin of the continental shelf, its animal life likewise spread with it.

Birds, from their comparatively high organization and their great freedom of movement, are exceptionally sensitive elements in any faunal group and are thus an indication of changes within a given region. Certain species are clearly related to certain habitats and a particular habitat is fundamentally dependent on vegetation which in turn is conditioned by the character of the soil, climate, of course, determining the broader phases of range. It is a well-known fact, as Mr. Witmer Stone observes in a recent letter to the writer, that "certain birds like the Prairie Warbler seem to be typical of the sandy coastal plain and occur *only* in it, just as with most of the coastal plain plants. The Gnatcatcher and Mockingbird are perhaps other species of similar distribution. Other Carolinian species like

Worm-eating, Blue-winged and Kentucky Warblers are very rare in the New Jersey coastal plain but plentiful in the rich wooded valleys of Pennsylvania. We have exactly similar cases in plants, very rare or absent in New Jersey (close to the Delaware if present) and common in the Susquehanna and other valleys in Pennsylvania. These distributions are probably by character of country."

Now by "character of country" I take it that Mr. Stone refers to just this condition of soil and vegetation influences that we have been discussing. Referring to the second query advanced in this paper, that of the efficacy of the fall-line as a faunal barrier, I must again quote Mr. Stone who has shown in a recent work,[1] the gist of which he gave me in a letter, that the fall-line in New Jersey and Pennsylvania forms a very sharp line of demarcation in plant life, the coastal-plain flora extending right up to its base, often crossing the Delaware River as at Tinicum and in eastern Bucks County. Such trees as the Sweet Gum (*Liquidambar*) and the Willow Oak (*Quercus phellos*), typical of the coastal plain, apparently never cross the "fall-line" in Pennsylvania. Mr. Stone finds a certain element of the upland flora crossing the fall-line into western New Jersey, especially along the Delaware, apparently taking possession of the richer soil, but the coastal-plain elements occurring west of the fall-line are found only in isolated bogs or in local, dry sandy areas. He is of the opinion that these are remnants of an earlier flora, similar to the present coastal-plain flora, which at one time covered the region above the fall-line and has been superseded by the present, more advanced flora, elements of which have come both from the North and the South, no doubt coincident with climatic changes, forcing life toward and away from the north polar region.

If the Carolinian and Alleghanian (and other) life zones be but relatively temporary conditions of a gradual shifting of faunas, it would seem that the differences in present soil-conditions on the two sides of the fall-line have made it a sharply defined line in the case of plants, especially in Pennsylvania

[1] Flora of Southern New Jersey. Annual Report N. J. State Museum for 1910, Trenton, 1912.

and New Jersey, where the slope is steeper and the conditions more contrasted than in the south. In the case of free-moving animals, notably birds, many Carolinian forms have easily crossed it and are continually pushing further and further to the north, where deforestation and resulting climatic changes makes this possible.[1] Another interesting fact is that of the Rose-breasted Grosbeak, an Alleghanian species, breeding at Haddonfield[2] and at Beverly, N. J.,[3] which, as Mr. Stone observes, "is exactly parallel to the occurrence of upland plants from Trenton down to Camden in West Jersey."

The significance of the fall-line, as a barrier to the northward extension of certain Carolinian species, seems to involve a difference in soil-formation affecting character of vegetation rather than any question of temperature, for the elevation of the upland is not more than one hundred feet above the lowland. The soils of the weathered crystalline gneisses of the upland are loose compared with the stiff, compact clays which fringe its foot.

The fact is not that these Carolinian species could not find favorable conditions in the upland section, but that they are part of an ancient biotic condition that has not advanced beyond this line. That there is a tendency to advance on the part of certain birds and trees there is no doubt, for we find an invasion of Carolinian types into such areas as the lower Connecticut Valley, where conditions, probably as a result of the old estuarine soils, offer favorable habitats. The Sweet Gum Tree and the Worm-eating and the Blue-winged Yellow Warblers are instances of this more northward dispersal beyond the ordinarily accepted limits of the fauna. Such species, likewise, invade the upland districts above the fall-line along the numerous streams that empty into the Delaware from the west. A fact also of some note is the abundance of winter bird-life on the

[1] See a paper by the writer on "The Geological and Geographical Relations of the Land Bird Fauna of Northeastern America." The *Auk*, Vol. xxvi, No. 3, July, 1909.

[2] Abst. Proc. D. V. O. C., iii, p. 10 (Moore).

[3] *Auk*, 1897, p. 323 (Reed).

coastal plain as compared with the uplands, probably due to the presence of considerable areas of woodland and marshland which offer greater facilities for obtaining food.

From what evidence has been gathered it appears that such typically Carolinian birds as the Blue-Winged, Worm-Eating, and Kentucky Warblers, the Acadian Flycatcher, the Carolina Wren, Tufted Titmouse and Carolina Chickadee, the Cardinal, the Chat and the Turkey Buzzard, all of which represent the more northerly element of what might properly be termed a *Coastal-Plain Fauna*, are in reality much more abundant in the coastal-plain tracts of southeastern Pennsylvania than in the upland districts; that the history of the region indicates a geologically recent invasion of a certain forest-type with its associate fauna along the coastal-plain border, and that this border lies against an ancient slope of crystalline rock-formation known as the fall-line or upland terrace which separates two very distinct topographic areas, a Piedmont land of great antiquity and a recently elevated strip of coastal sea-bottom. That a fauna does not represent a fixed state of things is evident from the numerous instances of the invasion of these types northward into localities that have become suitable as habitats. That temperature does not exert a controlling influence in this instance I think must be admitted. It is a question of difference of soil and of vegetation as conditioned by soil, and soils are a part of those ultimate geological processes, the influences of which are for ever working out the story of a long inheritance.