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THE NATURAL VEGETATION OF WESTERN LONG ISLAND SOUTH OF THE TERMINAL MORAINE

By Roland M. Harper

Introduction.—In the hundred years or so that New York has been a botanical center much time and energy has been expended in cataloguing the flora of the neighborhood, which consists largely of rather rare or imperfectly understood species; while very few persons have thought it worth while to study the vegetation, which is an important part of the landscape, and is mostly made up of common and easily identified species.* A considerable proportion of almost every local list of plants for a populous region consists of species which were not there a few hundred years ago, species not identified with certainty, species seen only once in the area, and records based on specimens from abnormal

* See Torreya 8: 156. 1908; Bull. Torrey Club 41: 557 (last footnote). 1914. The relation between flora and vegetation is much like that between anthropology and sociology, qualitative and quantitative chemical analyses, or dictionaries and literature. The services of a chemist who could make only qualitative analyses would not be worth much. Dictionaries are useful and well-nigh indispensable, but one does not need to know every word in the dictionary before producing any literature, and if all writers made revising the dictionary their chief aim we would not have much literature. Likewise one does not have to know all the plants of a region before describing its vegetation, and if all botanists were taxonomists primarily it would be difficult to get any information about the aspect of the vegetation in a region one had not visited.

For a concrete illustration of the difference between vegetation and flora see the treatment of those topics in the article on Florida in the latest edition of the New International Encyclopaedia (8: 708–709. 1914). A similar treatment for the whole United States was prepared for a later volume of the same work (22: 698–700. 1916), but there the flora part was crowded out entirely by exigencies of space, though the title still reads "Vegetation and Flora."

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habitats, that ought never to have been collected at all.* In such lists a single specimen of a rare weed is often given as much space as the commonest native tree, and sometimes even more.

At the present time one of the most obvious advantages of studying vegetation rather than flora is that it makes possible much more significant comparisons between different (especially adjacent) regions. By the old floristic method, in order to compare the plant population of two areas it is necessary to determine what species are present in one and absent in the other, which requires pretty thorough exploration; for the finding of a single specimen of a certain species a few feet inside the boundary of the area from which it was previously supposed to be absent necessitates a readjustment of the statistics. But a determination of what species are more abundant in one area than in another is accomplished more quickly (several of them can be picked out in one day if the areas are close together and well provided with railroads and not more than a few thousand square miles in extent), and is more useful in almost every way. For when the region of greatest abundance of a given species is ascertained, that not only gives the ecologist a clue to its optimum environment, but tells the economic botanist where to look for it if it is of any economic importance.†

* Many if not most collectors do not hesitate to take specimens from fields roadsides, railroad embankments, etc., when the same plants could be obtained just as well in undisturbed habitats near by. The labels ot such specimens, whether they indicate the habitat accurately, or—as is still a common custom, unfortunately —omit it entirely, tell little or nothing about the natural habitat of the species, which is of paramount importance. Worse still, a plant growing in a field may be a little out of its natural range, or larger or smaller or different in some other way from the same species in its native haunts, and in the course of time its descendants may even become specifically distinct, by mutation or otherwise (see Bull. Torrey Club 35: 355–356. 1908); so that placing such specimens in herbaria is likely to mislead the users thereof. Unless one is studying weeds, or the influence of unnatural environments on native species, ruderal plants should be let alone, for cumbering botanical collections with them may easily do more harm than good in the long run.

† Examples of the floristic method of comparison are common in botanical literature, but the following are among the most recent or easily accessible, or illustrate some special point: MacMillan, Metaspermae of Minn. Valley, 653 et seq. 1892; Beal, Rep. Mich. Acad. Sci. 5: 20. 1904; Harper, Torreya 5: 207–210. 1906; Fernald, Rhodora 9: 158–164. 1907; Gleason & McFarland, Bull.

This paper deals with a fairly homogeneous area within the limits of New York City, in which there is still enough natural vegetation to be well worth describing before it is all gone. It is that part of Kings and Queens Counties (or the boroughs of Brooklyn and Queens) south of the terminal moraine, which is a very conspicuous topographic feature in the western third of Long Island. The eastern boundary of the area under consideration is a political one, but it happens to mark almost exactly the western limit of the Hempstead Plains, whose vegetation is very different from that here described, and* the eastern edge of the extensive salt marshes around Jamaica Bay. The total area studied is about 100 square miles, including the marshes.

Geology and Soils.—The area is presumably underlaid at a considerable depth (100 feet or more) by Cretaceous strata of the coastal plain, which here have little or no influence on soil or topography. The surface material is classed by geologists† as "outwash" from the Pleistocene ice-sheet, which terminated at or near the present sites of Fort Hamilton, Prospect Park, East New York, Richmond Hill and Creedmoor.‡

There is no rock other than pebbles and small boulders of glacial or fluvial origin, which decrease in size and abundance

Torrey Club **41**: 511–521. Oct. 1914; Harshberger, Trans. Wagner Free Inst. Sci. **7**: 183–186. Dec. 1914; Taylor, Am. Jour. Bot. **2**: 26. 1915; Harper, Rep. Fla. Geol. Surv. **7**: 181–183. Sept. 1915; Bailey & Sinnott, Am. Jour. Bot. **3**: 25–27. 1916; Harshberger, Vegetation N. J. Pine-barrens, 181. Nov. 1916, For examples of the quantitative or census method and its applications see Coville Rep. Geol. Surv. Ark. **1888**[4]: 246–247. 1891; Harper, Bull. Torrey Club **34**: 363–366. 1907; Torreya **9**: 223. 1909; Bull. Torrey Club **37**: 113–117, 409, 417. 1910; Torreya **11**: 231. 1911; Plant World **15**: 245–247. 1912; Torreya **13**: 243–244. 1913; Bull. Torrey Club **41**: 562–563. 1914; Rep. Fla. Geol. Surv. **6**: 175 et seq. Dec. 1914.

* See Torreya **12**: 277–287. Dec. 1912.

† See U. S. Geol. Surv. Professional Paper 82, on the geology of Long Island, by M. L. Fuller, 1914.

‡ It is hardly possible to correlate the vegetation here with geological history, however, and the writer does not now attach the importance to such matters that some contemporary phytogeographers do. For vegetation of similar aspect, and most of the same species, can be found elsewhere on soils that are much older, while areas with similar geological history forty or fifty miles to the eastward have very different vegetation. The present environment is evidently more important—and incidentally much more easily determined—than any changes that have taken place in the past.

away from the moraine. (Consequently rock-loving plants are absent.) The prevailing upland soil types, in order of area, as mapped in the soil survey of western Long Island published by the U. S. Bureau of Soils in 1905, are "Hempstead loam" (this all in Brooklyn, and probably erroneously correlated with the typical soil so named in Nassau County), "Sassafras gravelly loam," "Norfolk sand," "Sassafras sandy loam," and "Hempstead gravelly loam." (These names indicate the character of the soils in a general way, and no attempt will be made to describe them. Descriptions and mechanical analyses can be found in the publication cited.) The salt marshes are mapped as "Galveston clay" and "Galveston sandy loam," and the dunes and beaches (Coney Island, Rockaway Beach, etc.) as "Galveston sand." No chemical analyses are available, but the soils are evidently distinctly non-calcareous, as elsewhere on Long Island.

Topography and Hydrography.—The highest altitude in the area is about 120 feet, in the northeastern corner, and the average slope to the southward is about 20 feet to the mile. The surface is nearly flat, except for the shallow and nearly straight valleys of several brooks and creeks flowing in a general southerly direction, and the dunes along the coast. Most of the valleys can be traced a mile or two above the points where the first water appears. As the crest of the moraine on the north coincides pretty nearly with the divide between the East River and the Atlantic Ocean, no permanent streams enter our area from the glaciated region, though of course some water runs down off the moraine in rainy weather. The streams are clear or nearly so, and sluggish. The salt marshes are dissected by tortuous tidal channels in the usual manner, and constitute the whole area of the numerous island in Jamaica Bay and a strip about a mile wide bordering the bay. The dunes are nowhere more than a mile from the outer beach, or more than ten feet high, and are moving very little at present.

Climate.—The climate of New York City is so well known that little needs to be said about it here. But for the benefit of readers in distant parts it may be well to state that the average temperatures for January, July, and the year are about 31°, 73°

and 52° F. respectively, the average growing season about 200 days, and the average annual precipitation about 45 inches. The normal monthly precipitation does not vary enough from one month to another to have any particular ecological significance, apparently.

Vegetation.—The uplands presumably were originally covered with forests much like the present-day remnants, and the streams were bordered by swamps, passing into meadows near their mouths. About 5 per cent of the original forest, including swamps, still remains, although there are now something like half a million people in the area. The swamps have been destroyed much less than the upland forests, because they are not so desirable for agricultural and residential purposes. The salt marshes, covering perhaps twenty square miles, and two or three square miles of dunes, are mostly in their natural condition yet, but are being invaded by houses more and more every year.*

In the list of plants below, for the sake of brevity, all the different natural habitats are combined. At some future time it may be possible or desirable to treat the upland forests, swamps, meadows, marshes and dunes separately, but it will hardly be possible to make satisfactory comparisons between the upland vegetation on different soils in this particular area, on account of the encroachments of civilization. In the list the habitat of each species is indicated as well as it can be done in two or three words, but without attempting any systematic classification of habitats. The upland forests vary from dry woods to rich woods, according to the amount of humus, etc. An intermediate condition between upland and swamp may be called low woods. The vegetation of dune hollows is intermediate between that of dunes and salt marshes.

The list is divided into five structural classes, namely, trees, small trees, woody vines, shrubs, and herbs. Bryophytes and thallophytes, which average much smaller than vascular herbs, are omitted, because of their small size (by reason of which they

*Although over thirty years has elapsed since the invention of the half-tone process, no published photographs of any natural vegetation (as such) in the area here discussed have come to the writer's notice; but the opportunities are not all gone yet by any means.

contribute almost nothing to the landscape), and the difficulty of identifying them in the field. The species in each structural class are arranged as nearly as possible in order of abundance, as determined by consolidating the field notes taken on ten or twelve walking trips through the area, mostly in the summer of 1916, in the course of which nearly every remaining patch of forest was visited. Although the numerical results obtained for each species are not yet sufficiently complete to warrant converting them into percentages, they make possible some significant comparisons between this and neighboring areas, which have not been possible before. It may be stated now, however, that the first tree listed makes up about 39 per cent of the present forest, the second about 19 per cent, and the third about 9 per cent, and the rest follow approximately in a geometrical progression. No such figures can be given for the herbs, on account of the difficulty of comparing the relative abundance of those scattered over wide areas of upland with those which are extremely abundant over limited areas of salt marsh.

Only the commoner native species are listed, but these probably make up at least nine-tenths of the total vegetation. The several hundred species not listed are either too rare, or too small to make much show, or are confined to unnatural habitats (though some of the last category are treated as native in current manuals). There will be plenty of time to study the weeds after the native plants are all gone.

The list may be criticized by some taxonomic specialists because some of the plant names are not in accordance with the latest developments in their line. The excuse is first that in rapid reconnoissance work it is simply impossible without long experience in the area studied to identify every species with absolute accuracy in the field, and out of the question to load one's self down with specimens to be studied later. Every plant seen in this sort of work has to be given some sort of name in the field notes, and if several species of such difficult genera as *Panicum*, *Sisyrinchium*, *Viola* or *Crataegus* are seen repeatedly within a short time it is difficult to be sure how many one has seen and to correlate the notes with the specimens. Further-

more, even if the plants were correctly identified according to the best existing knowledge, hardly a month passes but some taxonomist shows that what we have been regarding as a single species is really two or three, or that one of our plants is different from the southern or western or European species to which it was formerly referred; and it is hard for one who does not specialize in such matters to keep up with them. Fortunately minor errors of identification within generic limits do not materially affect the statistics.

As far as nomenclature is concerned Taylor's Flora of the vicinity of New York* is followed in the majority of cases. But acceptance of a particular style of nomenclature does not bind one to any particular conception of generic and specific limits, or preclude taking advantage of the latest taxonomic developments that may have come to notice. (For examples of the latter, see the footnotes in the list.

The list of plants now follows:

Trees

Quercus velutina	Upland woods
Quercus alba	" "
Hicoria alba†	" "
Castanea dentata†	" "
Acer rubrum	Swamps mostly
Quercus coccinea	Dry woods
Liriodendron Tulipifera	Rich woods
Quercus palustris	Low woods
Nyssa sylvatica	Swamps
Prunus serotina	Woods, etc.
Quercus montana‡	Dry woods

* Memoirs N. Y. Bot. Gard., Vol. 5, 1915.

† At present many of the hickories are dead or dying from the ravages of a bark beetle. The chestnut has been dying from canker for about ten years, but the dead trees and stumps are easily identified, and have been counted the same as living trees. As far as these trees are concerned therefore this list represents conditions as they were ten years ago.

‡ This has been commonly called *Q. Prinus* L., but that name belongs to a species of more southerly distribution, according to Sargent (Rhodora 17: 40, Feb. 1915).

Juniperus virginiana . . . . . Edges of marshes
Sassafras variifolium . . . . . Woods and swamps

Small Trees

Cornus florida . . . . . Dry woods
Betula populifolia . . . . . Various habitats
Sassafras variifolium . . . . . Woods, etc.
Populus grandidentata . . . . . Dry woods

Vines

Vitis aestivalis . . . . . Woods and swamps
Parthenocissus quinquefolia . . . . . " " "
Smilax rotundifolia . . . . . " " "
Rubus hispidus . . . . . Swamps and low woods
Celastrus scandens . . . . . Rich woods, etc.
Lonicera sempervirens . . . . . Woods
Rhus radicans . . . . . Woods and swamps

Shrubs

Viburnum acerifolium . . . . . Rich woods
Vaccinium vacillans . . . . . Dry woods
Gaylussacia baccata . . . . . Dry woods
Clethra alnifolia . . . . . Swamps
Myrica carolinensis . . . . . Dry woods and dunes
*Rubus nigrobaccus?** . . . . . Woods
Viburnum dentatum . . . . . Swamps mostly
Rosa virginiana . . . . . Dry woods
Benzoin aestivale . . . . . Rich woods and swamps
Alnus rugosa . . . . . Swamps and meadows
Rhus Vernix . . . . . Swamps
Sassafras variifolium . . . . . Woods, etc.
Gaylussacia frondosa . . . . . Swamps
Sambucus canadensis . . . . . Woods, swamps, etc.
Iva oraria† . . . . . Edges of marshes

† Formerly referred to *I. frutescens* L., which does not occur north of Virginia, according to Bartlett (Rhodora 8: 26, Feb. 1906).

* The blackberries have not been studied sufficiently. There may be more than one species.

Herbs

Spartina patens.....Salt marshes
Ammophila arenaria.....Dunes
*Spartina alterniflora glabra**.....Salt marshes
Carex pennsylvanica.....Dry woods
Panicum dichotomum?.....Dry woods
Distichlis spicata.....Salt marshes
Vagnera racemosa.....Rich woods
Lysimachia quadrifolia.....Dry woods
Solidago caesia.....Dry or rich woods
Eupatorium purpureum?.....Woods and meadows
Juncus Gerardi.....Salt marshes
Solidago bicolor.....Dry woods
Baptisia tinctoria.....Dry woods
Geranium maculatum.....Rich woods
Solidago sempervirens.....Edges of marshes
Aster divaricatus.....Rich woods
Falcata comosa.....Rich or damp woods
Meibomia nudiflora.....Dry or rich woods
Collinsonia canadensis.....Rich woods
Spathyema foetida.....Swamps
Impatiens biflora.....Low woods
Fragaria virginiana.....Dry woods
Potentilla canadensis?.....Dry woods
Angelica hirsuta.....Dry woods
Helianthus divaricatus.....Dry woods
Salicornia ambigua.....Salt marshes
Osmunda cinnamomea.....Swamps, etc.
Aralia nudicaulis.....Dry woods
Unifolium canadense.....Low woods
Panicum virgatum.....Edges of salt marshes
Limonium carolinianum.....Edges of salt marshes
Aureolaria villosa.....Dry woods
Silene stellata.....Rich woods
Panicum commutatum?.....Dry woods
Typha angustifolia.....Meadows, etc.

* *S. stricta* of American authors. See Fernald, Rhodora 18: 178, Aug. 1916.

Sericocarpus asteroides.....Dry woods
Pteridium aquilinum.....Dry woods
Solidago juncea?.....Dry woods
Dryopteris simulata?.....Swamps
Leptandra virginica.....Rich woods
Smilax herbacea.....Rich woods
Chamaenerion angustifolium.....Recently burned woods
Solidago rugosa?.....Woods
Dondia maritima?.....Salt marshes
Salicornia herbacea.....Salt marshes
Crocanthemum sp.....Dry woods
Sabatia stellaris.....Dune hollows
*Circaea latifolia**.....Rich woods
Galium circaezans?.....Dry woods
Sanicula marilandica.....Rich woods
Agrimonia sp.....Dry woods
Meibomia paniculata.....Dry woods
Spartina polystachya.....Brackish marshes
Eragrostis pectinacea.....Dunes
Scirpus americanus.....Dune hollows, etc.
Chamaesyce polygonifolia.....Dunes
Antennaria plantaginifolia.....Dry woods
Glycine Apios.....Swamps, etc.
Polygonatum biflorum.....Rich woods
Aster patens.....Dry woods
Meibomia rigida?.....Dry woods
Nabalus sp.....Rich woods
Strophostyles helvola.....Dunes
Scirpus Olneyi.....Brackish marshes
Andropogon maritimus.....Dunes
Atriplex hastata.....Brackish marshes
Hibiscus Moscheutos.....Brackish marshes
Lilium superbum.....Meadows
Meibomia marylandica.....Dry woods
Cakile edentula.....Dunes

* Until recently confused with the European *C. Lutetiana.* See Fernald, Rhodora 17: 222–224. Nov. 1915.

Lespedeza hirta.....Dry woods
Aureolaria Pedicularia.....Dry woods
Eupatorium sessilifolium.....Dry or rich woods
Juncoides campestre.....Rich woods
Meibomia grandiflora.....Rich woods
Carex vestita.....Dry woods

Quite a number of interesting conclusions could be drawn from this list by an enterprising reader, but only some based on the figures for relative abundance (which are not published for reasons previously given) will be mentioned here. It seems that not over 1 per cent of the trees are evergreen, about 41 per cent of the shrubs belong to the Ericaceae and allied families (Clethraceae and Vacciniaceae), and about 8 per cent of the herbs are leguminous plants. (The last figure, however, would be about doubled if the salt marshes were excluded, for there are no Leguminosae in them.)

This vegetation may now be compared, by means of data gathered in the same manner but not yet published, with that of two adjacent regions, namely, the glaciated portion of Queens County on the north, where the soils are more clayey and evidently richer, and swamps are scarcer, and the unglaciated portion of Nassau County on the east, where the soils are a little more sandy and evidently somewhat poorer on the average. The plants will be listed in the same order that they appear above, and where there is only one species of a genus listed the specific name is omitted to save space.

It is reasonably certain that the following are relatively more abundant in the area under consideration than in northern Queens County:—TREES: *Quercus alba, Hicoria alba, Acer rubrum, Quercus coccinea, Q. montana.* SMALL TREES: *Betula, Populus.* VINES: *Vitis, Smilax, Rubus hispidus, Lonicera.* SHRUBS: *Vaccinium vacillans, Clethra, Gaylussacia baccata, Myrica, Iva, Rhus Vernix, Gaylussacia frondosa.* HERBS (excluding salt marsh species): *Ammophila, Carex pennsylvanica, Panicum dichotomum, Solidago bicolor, Baptisia, Meibomia nudiflora, Spathyema, Fragaria, Angelica, Helianthus, Aralia, Unifolium, Osmunda, Aure-*

olaria flava, *Silene*, *Sericocarpus*, *Pteridium*, *Dryopteris simulata*, *Chamaenerion*, *Crocanthemum*, *Meibomia paniculata*, *Eragrostis*, *Chamaesyce*, *Meibomia rigida*, *Strophostyles*, *Andropogon*, *Lilium*, *Cakile*, *Aureolaria Pedicularia*, *Eupatorium sessilifolium*, *Carex vestita*. Some of these are chiefly confined to swamps, which are less common in the more northerly area, some prefer (or tolerate) poorer soils, while the reasons in a few cases are less obvious. A reverse comparison might be made by listing plants that are more abundant in northern Queens County than here, but that would involve bringing in several species that have not been mentioned before, and can better be deferred until the vegetation of northern Queens is discussed. It is well worth mentioning, however, that three trees which are common just north of the moraine, namely *Betula lenta*, *Fagus*, and *Liquidambar*, are almost wanting in the area under consideration. In the case of *Liquidambar* this is contrary to what one might expect in view of the fact that in the northeastern states it is almost confined to the coastal plain, and this is near its northern limit.

The following species are more abundant in southern Kings and Queens Counties than in the geologically and topographically similar portion of Nassau:—TREES: *Quercus velutina*, *Hicoria alba*, *Liriodendron*. SMALL TREES: *Cornus florida*. VINES: *Vitis*, *Celastrus*, *Lonicera*. SHRUBS: *Viburnum acerifolium*, *Rubus nigrobaccus?*, *Sambucus*. HERBS: *Vagnera racemosa*, *Solidago caesia*, *S. bicolor*, *Geranium*, *Aster divaricatus*, *Falcata*, *Meibomia nudiflora*, *Collinsonia*, *Impatiens*, *Fragaria*, *Silene*, *Leptandra*, *Circaea*, *Glycine*, *Polygonatum*, *Juncoides*. The significant factors in most of these cases seem to be richer soil and more protection from fire. In the western half of Long Island the natural soil fertility is greatest toward the west, and bodies of water and other barriers to fire are also closer together in that direction, a circumstance which favors the accumulation of humus.*

Comparisons with several non-adjacent regions could also be made, but if one should begin that it would be hard to decide where to stop.

If other botanists will study the vegetation of this and other

* See Bull. Torrey Club 38: 515–525. 1911.

easily accessible areas in this simple manner whenever they have opportunity for field work the accuracy of the foregoing statistics can be checked up, and at the same time significant similarities and differences, that are hardly suspected now, between different regions will be brought out.

College Point, L. I.

TYPE, COTYPE, AND TOPOTYPE LABELS

By E. D. Merrill

In all large herbaria that are rich in type material, the curator is confronted with the problem of properly indicating the important specimens, that is, those that are the actual types of species, cotypes of species, or in "collective species" those specimens that conform to the original type of the species as described, and agree with it as to origin. It is scarcely enough to indicate on the specimen that it is a type or a cotype, merely by writing these words on the sheet or on the label. Where one has to examine numerous sheets, as is frequently the case in large herbaria, before locating the critical specimen he is searching for, some special supplementary label is needed, one that is sufficiently prominent to attract the immediate attention of the herbarium worker.

In the Bureau of Science for a number of years the herbarium was stored in a wooden frame building, and one in which a large amount of chemical work was done. The danger of fire was always present. As the herbarium increased in size and value, and as the number of types and cotypes increased in number, it was felt that the critical material should be placed in a safer place. Accordingly all types and cotypes of Philippine species were segregated from the general herbarium, and stored in special cases which were in turn placed in a practically fireproof part of the Bureau of Science building. As to the number of specimens thus segregated, it is approximately 4,500 sheets. At the time the specimens were being segregated, each one was labelled with a special type or cotype label, as the case might be,