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SUGGESTIONS FOR FUTURE WORK ON THE HIGHER PLANTS IN THE VICINITY OF NEW YORK *

By Roland M. Harper

New York is one of Nature's strategic points. Three very important and entirely independent physiographic lines which do not intersect at any other one point, namely, the terminal moraine, the fall-line, and the coast line, pass right through the city, which therefore includes within its limits parts of the ancient highlands founded on solid rock, the unconsolidated coastal plain, and glaciated and unglaciated portions of both, as well as the beaches, dunes, and marshes of the coast itself, which is as distinct from the coastal plain as that is from the highlands. There is probably not another spot in North America, if in the world, which exhibits so much natural diversity in its immediate surroundings. Within fifty miles of here are considerable areas of Archaean, Palaeozoic, and Triassic rocks, some of them forming considerable mountains, as well as the nearly flat expanse of the Cretaceous and Tertiary coastal plain of Long Island and New Jersey, some of it covered with pine-barrens and some with fine oak forests. A circle with New York as its center and a radius of 100 miles, as shown by the Preliminary Catalogue of Anthophyta and Pteridophyta published by the Club in 1888, includes over half the species of vascular plants credited to the northeastern United States and adjacent Canada.

The earliest botanists in this rich region had their hands pretty full with merely collecting, identifying, and enumerating the flowering plants they found. Many species were at once seen to be new to science, and such had to be carefully compared and described;

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though most of the describing was done by European botanists up to about a hundred years ago. Others which were at first supposed to be identical with species already known from the Old World were gradually segregated and described as new. But by the middle of the nineteenth century the supply of new species of flowering plants and ferns in this part of the country had been almost exhausted, except in a few difficult groups which were beyond the comprehension of the average student. Even as far back as 1829 Amos Eaton made this statement in the preface of the fifth edition of his Manual of Botany: "There is not, probably, 50 undescribed species of Phenogamous plants in the United States — perhaps not one species, east of the Mississippi." (He lived to see the utter fallacy of this estimate, however.)

At an early period in the history of American botany, the recording of new localities for rare plants, and preparing floras of certain limited areas, became the favorite pursuits of the more ambitious amateurs, and the first few volumes of several of our best-known botanical journals were very largely devoted to studies of this kind. Good work in regional botany is still being done, but in this part of the country it is now hardly possible to prepare a "local flora" of the ordinary type without repeating a great deal that has already been published.

In the latter part of the 19th century many botanists who possessed the necessary training and equipment became diverted into the comparatively untrodden fields of anatomy, physiology, pathology, and cryptogamic botany. The opinion was expressed by a prominent botanist in a public address about twenty years ago that in the Eastern United States the non-professional botanist, without extensive library and herbarium facilities, could make the best use of his time available for research by studying the histology and development of particular plants. This kind of work is indeed valuable when well done, and the field is well-nigh inexhaustible, but the technique required for its successful prosecution places it beyond the reach of most of us.

The nomenclature agitations which began in this country about twenty years ago contributed hundreds of pages to botanical literature, and kept all classes of botanists busy for awhile learn-

ing new names in rapid succession. By the time comparative calm was restored, ecology came into prominence, and opened up a vast field for botanical research, which was quickly taken advantage of by many young students and even a few of the older men who had been trained in the herbarium or "lie-flat" school. (Up to this time, it should be observed, plants had been studied separately, *i. e.*, without reference to environment or associates, by systematist, phytogeographer, and physiologist alike.) But the fact that this new branch of science was soon invested with technicalities, and studied with the aid of elaborate apparatus, doubtless deterred many amateurs from following it. There was also a feeling in some quarters, especially in the eastern strongholds of conservatism, that ecology contained nothing new, that it was merely a rehashing of old facts which had long been known to botanists. And indeed it has not produced the striking results that some of its enthusiastic advocates expected it would, and in the last two or three years there has been a perceptible falling-off in the number of papers annually devoted to it.

Since the beginning of the present century the problems of mutation, hybridization, and experimental evolution have given occupation to a few specially trained investigators, and their work promises to be of great economic as well as scientific value; but it calls for persons of exceptional talents who are able and willing to spend years on a single problem before announcing results, and it has not measurably increased the opportunities of the amateur as yet.

At the present time nearly all the American botanical literature of permanent value is being produced by persons officially connected with museums, laboratories, and other institutions of research, or in other words, by professional botanists; but there is no sufficient reason why this state of affairs should continue indefinitely. Notwithstanding the serious inroads of civilization around New York, and the vast amount of work which has already been done on the plants of this vicinity in field, herbarium, laboratory, and library by several generations of the best-trained botanists in America, there are still awaiting solution here innumerable botanical problems which can be successively attacked

by any one possessed of a manual, a fair knowledge of plants, and a little spare time and perseverance. Some of them are distinctly outdoor problems, while others are of a statistical nature, and can be studied at home in winter and inclement weather, with the aid of field notes and a few books. For the amateur who wishes to make his work count the occasional assistance of a person familiar with botanical literature, to prevent duplication of research, is eminently desirable, but that is easily obtained in such a botanical center as New York.

Botanical field workers have always been inclined to pay too much attention to rarities, like mere curio collectors; and although it cannot be denied that finding rare plants is one of the botanist's chief pleasures, at the same time we can generally learn more from the common ones. It is really more important to determine what species are most abundant in a given region or plant association than to discover the rarer ones or even to make a complete list. Besides the common and rare plants there is another important category, commonly overlooked because they cannot be collected nor usually recorded in the field; namely, species which are absent from a given area or habitat and present in similar or neighboring areas.

In preparing local floras we should not be content with merely enumerating localities and habitats, unless the area is very small or very homogeneous. In a region with geometrical or political boundaries the distribution of each species should be correlated as far as possible with that of the various environmental factors, such as climate, altitude, geology, topography, etc. For instance, in this vicinity *Ilex glabra* seems to be confined to the coastal plain, *Quercus Prinus* to hilly or rocky regions, and certain ferns to limestone; while many species skip the pine-barrens, others do not grow near salt water, etc.

Most field botanists, especially in the northeastern states, have hitherto studied floristics rather than vegetation. The relations between these two concepts are analogous to those between orthography and grammar, grammar and literature, chronology and history, census statistics and geography, anatomy and physiology, or anthropology and sociology. In other words, while

the first is almost essential to the second, the second is far more interesting and valuable.*

The portions of the Eastern United States whose vegetation has been described in anything like a thorough manner at present constitute scarcely one per cent. of the whole, and, curiously enough, descriptions of vegetation are scarcest for some of the states in which botanists are and always have been most numerous. The plant habitats of the vicinity of New York are almost as little understood to-day as the plants themselves were in the time of Linnaeus, and even in some of the latest systematic works habitats are treated as unscientifically as plants are in non-botanical literature.†

North of latitude 35° and east of the Mississippi River no systematic classification of habitats seems to have yet been attempted for an area as large as a whole state,‡ though it would be a far simpler task to classify the few score of habitats in this part of the world than it has been to classify the several thousand species of plants.

An adequate description of a habitat would require as many words as a plant description, and would be out of place in the literature of systematic botany; but we should have a system which would enable us to designate any habitat accurately with not more than two or three words, just as a binomial or trinomial technical name suffices to designate any plant. Some ecologists believe that habitat names should be formed from the ancient languages, but it would seem as if our own language should be sufficient for the purpose, and that too, perhaps, without coining any new words. Of course there are now many short habitat names in common use, just as there were plant names before the days of systematic botany, but most of these are used rather

* For brief but illuminating comparisons of floristics and ecology see Clements, Research Methods in Ecology, 7–9, 1905; Bray, Bull. Univ. Tex. 82: 59–60. (Distribution and adaptation of the vegetation of Texas) 1907.

† See in this connection W. M. Davis, Am. Nat. 23: 579. 1889.

‡ An excellent beginning in classifying the vegetation of a small part of New England, with the novel feature of keys and descriptions for the habitats, was made by J. W. Blankinship in Rhodora for May, 1903, but it has not yet been followed up by any one else in that region.

loosely, and need to be given greater precision. For instance such familiar expressions as thicket, copse, glade, swale, grove, meadow, pine-barren, marsh, swamp, pond, sand-plain, and rich woods have never been adequately defined in terms of physiography, soil, and vegetation.

Photographs of vegetation are even scarcer than descriptions. Those for Connecticut, New York, and New Jersey which have hitherto appeared in botanical literature can almost be counted on the fingers, while some of the newer and more thinly settled states, such as North Carolina, Florida, Michigan, and Illinois, can make a much better showing in this respect. If members of the Club who possess the necessary apparatus would preserve records of the aspects of some of the natural habitats in this vicinity which are fast disappearing they would render a service of inestimable value to science.

As examples of natural vegetation within easy reach, the dunes and marshes of our coast are still in very nearly the same condition as they were a thousand years ago, and they offer a fertile field for study. We have as yet practically no description of any strand vegetation between Sandy Hook and the Bay of Fundy. The Palisades, which are almost in a class by themselves, have been greatly neglected by botanists. The largest natural body of fresh water and the highest hill on Long Island seem never to have been mentioned in botanical literature at all. The pine-barrens of Long Island and New Jersey have been damaged somewhat, but their original condition can be reconstructed fairly accurately. But all these places are being encroached on more and more every year, and they should be investigated without delay.

Turning to problems on a smaller scale, and perhaps more easily comprehended by beginners, it might be remarked that there is probably not one native species in North America whose average flowering period for any given locality has been determined within a week, and there are thousands of which we do not even know exactly the months in which their average periods begin and end. For most habitats we have only the vaguest idea of what proportion of the species are likely to be found in

bloom on any given date, or how long the flowering period of the average species in the habitat lasts, or at what hours the different flowers open and close,* which ones open only once and which open and close for several days in succession. These and numerous other phaenological problems which might be cited require no special knowledge for their investigation, and much can be done with them in a single season by any one who can get out in the field every week or so. For those who have some knowledge of entomology the study of the insect visitors of flowers presents an attractive field which has not been worked as much in this part of the country as it has farther west.

The exact mode of dissemination is practically unknown in many of our commonest plants, for example in such familar genera as *Panicum*, *Cyperus*, *Scirpus*, *Carex*, *Juncus*, *Polygonum*, *Hepatica*, *Potentilla*, *Lespedeza*, *Polygala*, *Lechea*, *Kneiffia*, *Convolvulus*, *Utricularia*, *Plantago*, *Ambrosia*, *Rudbeckia*, *Helianthus*, and numerous others easily recalled. And yet almost any plant ought to give up its secrets to the student who has patience enough to sit down beside it for awhile at the proper time.†

The local distribution of many species which reach their limits in this vicinity is very imperfectly known, even in the case of such common trees as *Pinus echinata*, *P. virginiana*, *Larix*, *Chamaecyparis*, *Quercus minor*, *Q. marylandica*, *Q. Phellos*, *Magnolia virginiana*, and *Liquidambar*.

A great deal of valuable information about the common names and economic properties of our native plants can still be obtained by going out in the rural districts and interviewing people who have never been influenced in any way by botanical literature.

* The time of opening and closing of flowers is not such a trivial matter as it might seem at first thought. It is one of the chief characters by which *Kneiffia* and *Oenothera* are distinguished, and it might prove equally useful in other groups which have not been so well studied.

† Such studies as these are commonly supposed to belong strictly to ecology; but would not systematic botany be considerably enriched if to the description of each family or genus could be added a few words concerning pollination and dissemination, instead of noting only such characters as are obtainable from herbarium specimens? As the mode of dissemination is usually the same throughout a genus, and even throughout some of the smaller families, such information would add very little to the size of our manuals, even if nothing of less importance was omitted to make room for it.

The character of some of the many unsolved botanical problems which confront us can perhaps be illustrated best by the following set of questions. * These are submitted with the assurance that answers to most of them have never yet been attempted, although they should present no great difficulties. Members of the Club who can suggest answers, or other questions of similar nature, are urged to do so.

What proportion of our local flora (or of the flora of any particular region or habitat) consists of trees? shrubs? vines? evergreens? parasites? annuals? biennials? anemophilous species? conifers? monocotyledons? grasses? sedges? Rosaceae? Leguminosae? Umbelliferae? Ericaceae? Compositae?

In what habitat or habitats is each of the above groups (or any other large group of plants) most prominent?

To what families and habitats do most of the plants belong that bloom in spring? summer? fall? What is the first spring flower in each habitat?

Why are some species common and some rare? Do the common and rare ones tend to belong to any particular habitats or taxonomic groups?

Do closely related species (not merely congeneric, but so close that no others come between) ever have the same range or habitat, or both? If so, do they ever grow close together? Give examples, if possible.

In what families and genera do natural hybrids occur?

Are two modes of dissemination ever found in the same genus? Give examples.

In what families, genera, and habitats do we find plants that perform sleep movements? Plants with fleshy or barbed fruits? With blue or red or odorous flowers? Carnivorous plants?

What weeds prefer roadsides? pastures? vacant lots? cultivated fields? abandoned fields? barnyards? burned areas? recent clearings? What proportion of annuals, biennials, and perennials in each habitat?

* Editor's note. — Here is abundant material for field work in our high schools, normal schools, and colleges. The questions will also prove suggestive for work during the long vacations which most teachers consider difficult to plan.

On Long Island what species grow only north or south of the "backbone" of the island? (A similar inquiry could be made relative to the terminal moraine in New Jersey and Pennsylvania.)

What species occurring at similar altitudes and latitudes on the mainland are wanting on Long Island, and why? What species native in Suffolk County do not grow in Nassau or Queens, and *vice versa?* To what families and habitats do such species mostly belong?

Why do a good many pine-barren plants occur in the eastern half of Long Island and not in the western half?

What native species and genera in our vicinity are common to the Pacific slope? the West Indies? South America? Europe? Asia?

What proportion are endemic to Eastern North America?

What proportion of the species in our local flora, or in the northeastern states, were known to Linnaeus? Michaux? Pursh? Torrey & Gray?

What proportion still bear the names that these authors used for them?

What species have their type-localities in this vicinity (or in any limited area, such as New Jersey)?

What new genera (if any) were discovered in the northeastern United States during the 19th century?

What geographical names in this vicinity were derived from native plants?

What are the natural (or prehistoric) habitats in this vicinity of *Pinus virginiana, P. Strobus, Juniperus virginiana, J. communis, Acorus Calamus, Spathyema foetida, Juncus effusus, J. tenuis, Andropogon scoparius, Panicum virgatum, Scirpus atrovirens, Carex lurida, Juncoides campestre, Smilax rotundifolia, Juglans nigra, Carpinus caroliniana, Betula populifolia, Quercus alba, Q. palustris, Q. Phellos, Morus rubra, Ulmus americana, Celtis occidentalis, Polygonum pennsylvanicum, Polygonella articulata, Claytonia virginica, Liriodendron, Ranunculus abortivus, Menispermum, Sassafras, Liquidambar, Rubus occidentalis, Potentilla canadensis, Prunus serotina, Cassia marilandica, Gleditschia, Robinia Pseudacacia, Acalypha virginica, Rhus hirta, R. glabra, Ilex opaca,*

Celastrus scandens, *Sarothra gentianoides*, *Oenothera biennis*, *Isnardia palustris*, *Cornus alternifolia*, *Epigaea*, *Gaultheria*, *Fraxinus americana*, *Diospyros*, *Obolaria*, *Gentiana crinita*, *Bartonia*, *Asclepias syriaca*, *Convolvulus Sepium*, *Verbena hastata*, *V. urticaefolia*, *Prunella vulgaris*, *Linaria canadensis*, *Pedicularis canadensis*, *Melampyrum*, *Plantago Rugelii*, *P. virginica*, *Houstonia caerulea*, *Sambucus canadensis*, *Lonicera sempervirens*, *Micrampelis lobata*, *Specularia perfoliata*, *Ambrosia trifida*, *A. artemisiaefolia*, *Xanthium canadense*, *Eupatorium perfoliatum*, *Chrysopsis falcata*, *Solidago canadensis*, *Aster Novae-Angliae*, *Antennaria plantaginifolia*, *Anaphalis*, *Erechthites*, and the various species of *Panicum*, *Chaetochloa*, *Carex*, *Sisyrinchium*, *Rubus*, *Fragaria*, *Crataegus*, *Viola*, *Physalis*, *Lactuca*, *Solidago*, *Euthamia*, and *Aster?*

Are *Pinus echinata*, *P. virginiana*, *P. Strobus*, *Larix*, *Picea*, *Tsuga*, *Eriocaulon decangulare*, *Betula nigra*, *Quercus acuminata*, *Q. Phellos*, *Morus rubra*, *Platanus*, *Prunus serotina*, *Rubus occidentalis*, *Acer saccharinum*, *A. pennsylvanicum*, *Diervilla* (and various other species) native on Long Island? If so, where? (Many supposed native species in other regions should be subjected to similar inquiries.)

Some of the above questions may seem at first to be of no earthly use, but if studied conscientiously their bearing on other important problems will become evident, and at the same time entirely unexpected lines of inquiry may be developed. All of nature's laws are worth knowing, whether they seem to have any immediate practical bearing or not. Of course most of us do not have much time for field work, but what time we do have might as well be spent in studying some of the newer phases of botany, and making distinct contributions to knowledge, as in merely collecting and identifying plants as our predecessors did a hundred years ago. If in all our field work the structures and adaptations of plants are studied in relation to environment and distribution many interesting correlations can be made, and we will gradually come to understand why each species grows where it does, which ought to be the aim of every field botanist.

The following discussions of the past, present and future prob-

lems of American botany will be found full of valuable suggestions along the lines above indicated. Most of them are public addresses by well-known men, and nearly all can be found in the library of the New York Botanical Garden. The arrangement is chronological.

Brendel, F. Historical sketch of the science of botany in North America from 1635 to 1840. Am. Nat. **13**: 754–771. D 1879; Do. 1840 to 1858. Am. Nat. **14**: 25–38. Ja 1880.

Gray, Asa. Remarks concerning the flora of North America. Am. Jour. Sci. III. **24**: 321–331. N 1882; Bot. Gaz. **7**: 129–135, 139–143. 1882; Proc. A. A. A. S. **31**: 449–460. 1883.

Farlow, W. G. The task of American botanists. Pop. Sci. Mo. **31**: 305–314. Jl 1887. Abstract in Bull. Torrey Club **14**: 173–174. Au 1887.

McCarthy, G. The study of local floras. Jour. Elisha Mitchell Sci. Soc. 4^2: 25–29. 1887.

Coulter, J. M. The future of systematic botany. Proc. A. A. A. S. **40**: 293–304. 1892.

MacMillan, C. On the emergence of a sham biology in America. Science **21**: 184–186. 7 Ap 1893. (Discussed by four other persons in later numbers of the same volume.)

Trelease, Wm. Botanical opportunity. Bot. Gaz. **22**: 193–217. S 1896.

Kearney, T. H. The science of plant ecology. Plant World **2**: 158–160. Jl 1899.

Barnes, C. R. The problems and problems of plant physiology. Science II. **10**: 316–331. 8 S 1899; Proc. A. A. A. S. **48**: 263–288. D 1899.
See especially pages 327–329 and 282–286, on ecology and plant names.

Halsted, B. D. The new field botany. Pop. Sci. Mo. **56**: 98–105. N 1899.

Trelease, Wm. Some twentieth century problems. Science II. **12**: 48–62. 13 Jl 1900; Proc. A. A. A. S. **49**: 249–272. 1901.

Underwood, L. M. The last quarter—a reminiscence and an outlook. Science II. **12**: 161–170. 3 Au 1900.

Hitchcock, A. S. A brief outline of ecology. Trans. Kan. Acad. Sci. **17**: 28–34. 1901.

Robinson, B. L. Problems and possibilities of systematic botany. Science II. **14**: 465–474. 27 S 1901.

Trelease, Wm. The progress made in botany during the nineteenth century. Trans. Acad. Sci. St. Louis **11**: 125–142. 26 N 1901.

Haddon, A. C. The saving of vanishing data. Pop. Sci. Mo. **62**: 222–229. Ja 1903.

Spalding, V. M. The rise and progress of ecology. Science II. **17**: 201–210. 6 F 1903.

Ganong, W. F. The cardinal principles of ecology. Science II. **19**: 493–498. 25 Mr 1904.

Cowles, H. C. The work of the year 1903 in ecology. Science II. **19**: 879–885. 10 Je 1904.

Reed, H. S. A brief history of ecological work in botany. Plant World 8: 163–170, 198–208. 1905.

Robinson, B. L. The problems of ecology. Cong. Arts & Sci. (St. Louis, 1904) **5**: (1–13). 1906.

Underwood, L. M. The progress of our knowledge of the flora of North America. Pop. Sci. Mo. **70**: 497–517. Je 1907.

Some suggestions as to interesting and unusual ways of working up a local flora can also be found in Beal & Wheeler's Michigan Flora (1892), and on the first thirty pages of Beal's Michigan Flora (Fifth Report Mich. Acad. Sci., 1904).

OTHER TERATOLOGICAL NOTES

By S. B. Parish

1. *Foliar fission in Polystichum munitum.* — A plant of this fern, growing in the San Bernardino Mountains, exhibited in its different fronds a wide range in the extent to which they were affected by fission. This was very slight in some, but in others the normal form of the pinnae was greatly modified. The accompanying figure, from a drawing by Mrs. C. M. Wilder, renders further description unnecessary.

2. *Polyphylly of the Gynecium in Washingtonia.* — The ovary of *Washingtonia* consists of three conjoined carpels uniting in a common style. In a flower of *W. gracilis* two such ovaries, entirely distinct throughout, were included in the same calyx.