

selves to cultivated ground and what must confine themselves to strictly wild lands.

These facts should be noted not only in reference to the indigenous plants, but so far as they are applicable to introduced plants also. In reference to this latter class, the following points ought to be noted in addition: (1.) The time and circumstances of introduction so far as this can be ascertained. Many of our most notable weeds have long been under the observation of farmers and it is often possible to obtain from them valuable information as to the invasion of certain weeds. (2.) The vigor of introduced plants as compared with native plants ought always to be noted. This, of course, will involve an investigation as to what foreigners have been able to successfully make their way against what natives. (3.) Under the head of economic importance, the introduced plants are to be considered in relation to their injury to crops.

In Indiana not only should these general features of native and introduced plants be studied, but also certain special problems which belong to the state in its relation to other states and to the general topography of the Mississippi valley. The biological survey should have in view some of these special problems whose answer will probably contribute more to real botanical knowledge than the more general study of the state flora. Certain problems are here suggested to which many more may be added:

- (1.) The eastward extension of the prairie flora.
- (2.) The southern extension of the flora of the Great Lakes.
- (3.) The northern extension of the southern flora.
- (4.) The "Knob" flora.
- (5.) Flora of the limestone cliffs.
- (6.) The floras of various soils.

Under the last head Dr. Scovell suggested the "sand-bar flora" along large streams, and W. P. Shannon suggested the flora of the "white clays."

THE PHANEROGAMIC FLORA OF INDIANA.

By STANLEY COULTER.

The knowledge of the phanerogamic flora of Indiana while somewhat extended is far from satisfactory. Many excellent and some few noteworthy regional lists have been published as well as a provisional state catalogue, yet all leave much to be desired. It is unnecessary in this connection to deal in detail with the bibliography, since it is treated in an

earlier paper in this volume by Dr. Underwood. The following features however may be noted which will serve to show what is yet lacking for a complete knowledge of the phanerogamic flora of the state

All of these lists, with perhaps the exception of those of Dr. J. Schneck, and Dr. A. J. Phinney, are limited by *political* instead of *natural* boundaries. It is evident that while such limitation is popular and apparently in some cases necessary, it cannot result in publications which will furnish a basis for any useful generalizations without the most painstaking and arduous comparisons. Many apparent anomalies in distribution would doubtless be explained were the lists based upon natural divisions. In the exceptional lists referred to above, that of Dr. Schneck treats of the flora of the lower Wabash valley, thus necessarily including certain counties in Illinois as well as in Indiana, while that of Dr. Phinney refers to the Alpine region of Indiana and includes the four counties of Delaware, Wayne, Randolph and Jay. In both these lists, however, the political boundary is the final limitation. In the rather picturesque language of Prof. MacMillan—"Just as we should not attempt to interpret the laws governing the action of a constitutional convention by periodic examinations of a mercury-barometer, no more should we attempt to investigate the laws of plant distribution by adhering to the artificial lines which separate from adjacent commonwealths, or divide into counties or sections." The seven botanical regions indicated in Coulter and Thomson's *Origin of Indiana Flora* (vol. XIV., State Geol. Rep. pp. 256-7), while not perhaps strictly natural in all particulars will at least serve as a basis for present work, being established upon topographical and geological features.

A second feature to be noted in the lists mentioned above is, that in no single instance, so far as come to my knowledge, can the list be authenticated by herbarium specimens. In most cases the belief in the existence of a plant in any given locality rests solely upon the word of the collector. Those of us who know the necessity for critical study and careful comparison which obtains in so many species, recognize at once the unsatisfactory nature of such data. Given a sufficient paucity of specimens added to a desire to make as large a local list as possible and the factors are present for the introduction of many species "new to the state." I examined last year a bundle of seventeen plants "new to the state," and found eleven of them incorrectly determined. I do not mean to depreciate in the slightest the valuable lists already published, or to question the botanical knowledge and acumen of their authors. I only wish to empha-

size the fact, that in many forms an accurate determination is almost utterly impossible without opportunity for extended comparison. And the more extended the worker's experience in systematic research, the more convinced is he of this fact.

By an examination of the State Catalogue supplemented by lists, published and unpublished, most of which are in my hands, I estimate the phanerogamic flora of the state at between 1,300 and 1,400 species, excluding plainly evident "escapes" and the ferns and their allies, both of which are usually included in the totals furnished in the lists. Of this number I very much doubt if 900 species can be authenticated by all the herbaria of the state combined, including in this estimate all forms in private herbaria. This condition of affairs, if my estimate is correct, certainly shows the need of a careful and scientific revision of our state flora.

The criticism of existing catalogues is not made in a captious spirit, but for the sole purpose of showing how much is yet to be desired in the way of absolute facts before any satisfactory report of the phanerogamic flora can be made.

A critical examination of the various publications bearing upon this subject will indicate that many regions of the state have not been investigated in a way at all commensurate with their botanical importance. Of these regions I will only mention a few specifically: The "Knob" region, studied somewhat extensively by Dr. Clapp of New Albany, 1834-38, but since that time practically untouched. Many species in the State Catalogue rests solely upon the collections of Dr. Clapp, and can, I believe, in most cases be authenticated by herbarium specimens. This whole range of hills should be carefully investigated. The swamp and lake region in the northern central portion of the state has been almost untouched, if we except some few collections from the borders of prominent lakes and the researches of E. J. Hill in the district south of Chicago. To these might be added the tier of counties abutting upon Michigan and the western tier of counties from Vermillion northward. To one at all acquainted with the topography of Indiana it is evident that most promising fields still remain open for investigation.

The main purpose of a catalogue of the phanerogams of the state, is not the list, however complete and accurate this may be, but the data accompanying each form, which aid in determining the principles governing plant distribution, or serve, at least in some slight way, to resolve into simpler terms some of the complex factors of this problem.

An examination of the conditions affecting plant distribution, as has been admirably shown by F. V. Coville, U. S. Botanist (Botany of the Death Valley Expedition, pp. 10-19), from a utilitarian point of view, is of the greatest importance. In speaking especially of trees and shrubs he says: "They therefore stand as the most complete summation that can be attained of the natural light, heat, moisture, food, air and mechanics of any area: in other words, a sure index of the natural agricultural capacity of the soil upon which they grow. * * * It has been the practice of agriculturalists to gauge the capacity of soils, in regions new to the plow, by observations on rainfall, temperature, cloudiness, chemical composition of the soil, drainage, and many other phenomena, or by the even more laborious process of experimenting on every farm with each kind of cultivated product; ignoring the fact that this determination can be greatly hastened, cheapened, and authenticated by correlating the natural vegetation, especially that made up of the trees and shrubs, with that of other regions whose agricultural capacities are known." The list then is merely incidental, and its accompanying data furnish the only scientific or economic reasons for its preparation.

With this in mind it is evident how completely our existing local lists fail in furnishing facts from which any useful conclusion can be drawn. In most cases nothing beyond the words "common," "not rare," "abundant," "very rare," are given, and in some of the lists even these are omitted. In one list only, which at the moment I recall, are any facts bearing upon the *habitat* given. It is true that in exceptional forms, such as *Sullivantia Ohionis*, T. and G. or *Brachychata cordata*, T. and G., valuable notes may occur, but the instances are exceptional.

That the proposed biological survey of the state may fully accomplish its purpose, the work upon the phanerogamic flora should in the future proceed under certain definite conditions and for the accomplishment of certain definite results. Primarily the data collected should be of such nature and in such form as to be readily correlated with similar work done in other states. That this may be accomplished it is necessary that similar data be collected and terms technically employed shall have an uniform meaning.

The words which have given rise to perhaps the greatest confusion by lack of uniformity in meaning, are the words: *range, locality, station and habitat*. I quote from F. V. Coville (Botany of Death Valley expedition, pp. 10), "The meanings that should logically be attached to these words are as follows:

“*Range*—The region over which a type spontaneously grows.

“*Locality*—The approximate geographic position of an individual specimen.

“*Station*—The spot upon which the specimen has been collected or observed.

“*Habitat*—The character of the place in which a type occurs.”

To illustrate the use of these terms Mr. Coville takes *Juncus cooperi* and the particular specimens of it collected under No. 204 of the report, tabulating the data as follows:

“*Range*, in the lower Sonoran zone from Vegas Wash, Nevada, westward in California through the Amargosa valley, Death valley and Panamint valley, and again at Borrego Springs in the Colorado desert.

“*Locality*, Death Valley, California.

“*Station*, edge of salt marsh about 400 meters east of Bennett Wells, Death Valley, California.

“*Habitat*, densely alkaline moist soil, apparently only that containing compounds of boracic acid.”

I have given this extract in full for the purpose of showing what a complete record is essential to the fullest knowledge of a flora, and also to emphasize the importance of “mass distribution” embraced under the head range, a fact rarely given by untrained collectors. As this series of definitions proceeds from the office of the Government Botanist they may be used in full assurance of their ready correlation. In the collection for the purposes of the proposed biological survey then, collectors should as far as possible, record in a concise and systematic manner, the following data: 1. Range, 2. Locality, 3. Station, 4. Habitat, 5. Local peculiarities, 6. Name, if known, 7. Date, 8. Abundance.

All notes should be kept in a note-book, the plant being known by a serial number, and the name of the collector.

Serial numbers should be carried forward from season to season. Thus if the last serial number of 1893 was 378, the first number of 1894 should be 379. Plants then are known by the number, the name of the collector and the date, as “2162 Jones 1893.” By this means plants are readily identified wherever they may be distributed, and provision made for future revision and correction.

Should a special collecting trip be made, the following additional notes should be recorded: 1. Itinerary, 2. Weather, daily, 3. Noteworthy plants observed but not collected.

In all cases as far as possible such ecological notes as are of value should be entered in the record. The note-book should also show under the proper serial number, the quantity of that form collected.

It is of course too much to expect in a voluntary work such as that proposed by the State Academy that every person who aids in the work will be able to keep typical records, for that is possible only in the case of specially trained collectors, but with a full knowledge of the facts needed each person contributing to this work can add some fact not definitely known concerning our state flora.

In a general way collectors should secure a sufficient quantity of any given form to admit of distribution into sets, a fact which should be especially observed in the case of rare plants or those of local distribution. This advice does not point in the direction of the extermination of such forms, for in all cases the collector, inferentially at least, is supposed to be free from any tendency to vandalism. They should also be careful in all cases to make *complete* specimens, a work that will necessitate some preliminary study of the different groups. Perhaps the most valuable sets of directions which we have for collectors are to be found in the publication of F. H. Knowlton of the Smithsonian Institute, and the collector's number of the Botanical Gazette (vol. 11 No. 9). An examination of either of these publications will serve to assist the collector in his work and also add much to the value of his collection. Those intending to collect should notify the person in charge of the phanerogamic flora, in order that he may suggest to them special points for investigation and study. Through these special studies much of value may be accomplished.

It is evident from the preceding pages that in my opinion, the work, as far at least as the phanerogams are concerned, should be placed in the hands of one person. He should assign special groups for determination to those specially fitted for the work and should indicate as far as possible the regional problems for investigation. It would, under such conditions, be possible to effect such co-ordination of work that the results would be not only of scientific but of economic value.

Material should be collected, so that complete and authenticated sets could be distributed to each college maintaining a herbarium, and from which duplicates of special noteworthy forms could be furnished to the specialists of the country. It should be a great, working herbarium, thoroughly representative of the state, and sufficient for all the demands that would naturally be made upon such a collection.

It was my purpose to consider in this paper the various collections of the state, private as well as those owned by the various colleges, but the necessary data are not yet in my possession. I trust however at the spring meeting of the Academy to present a tabulated statement covering these points.

This paper, submitted to the Academy at the request of the directors of the state biological survey, is merely an expression of my own personal views, the exact form which this work may take lying wholly in their hands.

**THE RELATIONS OF THE HIGH SCHOOLS OF INDIANA TO THE
PROPOSED BIOLOGICAL SURVEY.**

By W. S. BLATCHLEY.

In my opinion the high schools of the state could, in the presence of the proper conditions, be made a most important factor in the prosecution of the proposed survey, and could themselves derive much benefit from it. But, in probably the majority of cases, the conditions are lacking, and before they can be brought about I am afraid the survey will have long since been completed.

It is to the teacher of biology, if to any one in the faculty of the high school, to whom the survey must look for aid. He, or she, alone of the faculty, is supposed to be interested in birds, bugs and flowers to such an extent that they can readily instill in the minds of their pupils that desire to know more of the secrets of nature and of the life history of her varied objects which will cause those pupils to be on somewhat intimate terms with their local fauna and flora, and so be able to note to some degree the more rare and interesting forms of animal and plant life about them, to be able to record the abundance of these forms, their local distribution and the causes thereof, in short all facts which may afterwards be of aid to the directors of this survey and their assistants.

Only teachers who are themselves enthused with the subject can beget the necessary enthusiasm in their pupils, and it is to such teachers as leaders, therefore, to whom the survey must look for aid.

Let us consider then the high school biology teachers of the state as a class, and see whether much should be expected of them by the survey.