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When some years ago the reaction against the "old botany" and in favor of plant morphology, and later plant physiology, took place, systematic botany was pushed into the back-ground, indeed in many of our institutions it was barred entirely.

It was not long, however, until a counter-reaction set in, and the appreciation of systematic botany has been slowly but steadily growing. Unfortunately the period of practical ostracism was sufficiently long to permit a generation of botanists to develop with practically no knowledge of this subject.

In the meantime older methods and even the terminology were largely forgotten, and various terms, such as "secondary roots," etc., are no longer used in the orginal sense. The detailed study of the organography of the flower, so essential to an understanding of classification and to accurate identification, was largely given up and the use of accurate keys for identification became almost a lost art.

With the return of the appreciation of the need of a knowledge of the identity of plants and of their relationship, there came a desire for quick, easy methods of which mere identification was the chief aim. As a result of this demand for ready "plant-finders" very superficial keys were devised for general use and for classes in general botany.

Such keys are inaccurate and unfair to the student because they give a wrong impression of possibilities. Perhaps the common use of bird-keys has contributed to this tendency, but it must be remembered that birds reach a definite mature state in size and coloration, whereas plants are exceedingly variable, their variations often resulting from differences in habitat. Our common bur-oak, for example, varies from a small shrub, scarcely a foot in height, to a splendid forest tree; the greater ragweed (*Ambrosia trifida*), some of the larger sunflowers (*Helianthus*), the marsh elder (*Iva xanthiifolia*), and many other normally large species measuring several feet in height, may flower and fruit when but a few inches high; the poison ivy (*Rhus Toxicodendron*) may be a low shrub or a high-climbing vine; and many species show a corresponding

variation in the form and size of their leaves, flowers and other parts, the hairiness of the surface, etc.

In many cases other variations, not induced by environment, are equally confusing. Thus the color of the flower in the hepatica and Carolina anemone (*Anemone caroliniana*) is extremely variable; the form and division of the leaf in the mulberry, box elder and bur oak may vary greatly not only on trees occupying the same habitat, but upon the same individual; the bark on trees and shrubs changes greatly with age; stems of the same species may be thorny or thornless, as in the honey locust; while fruits may vary in color and seeds in size and markings in the same species.

These variations make it exceedingly difficult to prepare artificial keys based on superficial characters, and such keys should be prepared with great care only for rather limited areas; and in all cases the identification should be verified by reference to more complete manuals.

The desirability of a more thorough and systematic study of plant taxonomy will be more fully appreciated by reference to a summary of its uses and purposes. These may be grouped under three heads: cultural value, aid to professional botanists, and general service.

1. *Cultural value.* — If properly conducted the taxonomic study of plants develops powers of observation and of correlation, and may be well employed for the training of descriptive powers, for it is quite as important that students be taught to describe objects as to express abstract thought.

Contact with the living world, if properly directed, should also develop a considerate, sympathetic attitude of distinct ethical value.

The danger in taxonomic effort lies in the possibility that the work of identification and description may become mechanical, but this can be avoided by following the comparative method hereinafter described.

2. *Aid to professional botanists.* — It should require no argument that the professional botanist ought to know the materials with which he works, no matter what may be his particular field of effort. Yet large numbers of students majoring in botany and intending to enter the professional field, have been (and are still being) graduated without learning how to determine the members of their local flora accurately.

Teachers of botany especially should be able to make such

determinations, for plants are constantly being brought to them with the question "what is it?" The teacher should be able to answer this question with fair frequency and with reasonable accuracy. For this purpose neither slipshod, careless methods of identification nor a mere effort to keep up appearance will suffice. The instructor who presents a Potentilla to his class and calls it a buttercup, or who calls a Dodecatheon an orchid, or a Chinese tree-of-heaven a Kentucky coffee-bean, will soon be found out by his class, to his own great disadvantage.

Plant morphologists and physiologists should know their material both for purposes of selection and of record, and the student of genetics should have that knowledge of plant variation which is secured only by a careful taxonomic study of plants.

The plant pathologist finds the knowledge of the host plant quite as important as that of the parasite, and he should be an expert taxonomist.

The plant ecologist requires the same knowledge and experience to appreciate plant-variations which are related to environment, and his floristic records require great accuracy in making determinations if they are to be of value.

The economic botanist surely needs to know the source of his materials, and if he is concerned with the study of such subjects as trees, weeds, or industrial or medicinal plants, accurate identification of the species is indispensable if his work is to be reliable.

Indeed, there is practically no line of botanical effort in which a taxonomic knowledge is not essential, or at least of great value.

3. *General service.* — Few persons are not directly interested in planting for ornamental and other purposes. The average citizen would often save himself much disappointment and expensive failure in tree-planting if he knew our common trees and their habits, and the crop-grower could better fortify himself against loss if he could early determine the invading weeds which menace his profits.

The returning interest in outdoors also makes the general knowledge of plants much more desirable and necessary. Interest in our native plants is being fostered by the women's clubs, garden clubs, Boy and Girl Scouts, Campfire Girls and other organizations, and the more practical side is being developed through the Farm Bureau and organizations like the Izaak Walton League. It is evident that all who are engaged in directing such work should have a working knowledge of our more common plants.

The increased use of the automobile and the opening of our

state and national parks to tourists is menacing the remnant of our attractive wild flowers and a general intelligent interest in this remnant, which can best be secured by systematic study, is extremely desirable.

What can be done.

The remedy for the widespread lack of knowledge of the identity of our plants is to be found in systematic study. As noted, short-cut methods are unreliable and hence undesirable. The teaching of taxonomic botany should be introduced into every high school, and where necessary it should replace the college courses which have been projected into many secondary schools. The ordinary general courses in botany requiring a laboratory equipment give to the pupil who does not go to college very little in which he can keep himself interested after graduation from the laboratory; and most college instructors will agree that such courses as usually presented are of little value to those who go on with the work in college. Too often they create a distaste for the subject, or develop the conceited and mistaken notion in the mind of the pupil that he knows all that is necessary of the subject.

The work in plant taxonomy can be taken up successfully in the high school and will not in any way interfere with the presentation of laboratory courses in college. The student who continues his botany in college should take up the more critical phases, such as the detailed study of special groups, the rules of nomenclature, etc., and this should be done early in the course. Taxonomic botany is the hand-maid of all branches of botany and not a mere introduction to any of them, and if it is to serve its best purposes it should be at the student's service throughout his more advanced efforts. To give this to him late in the course is offering him a working-tool when the job is nearly completed.

After forty-four years' experience in teaching plant taxonomy, during wihch various methods of approach were tried, the writer is convinced that the best method of approach is that which may be designated as the comparative method. For flowering plants this may briefly be outlined as follows:

First secure a fair working knowledge of the organography of the plant and begin the development of a descriptive vocabulary. Learn to use the key for identification quite early.

Then select a representative of a larger family, such as a buttercup, and have a complete description of the plant written, with special emphasis on the family and generic characters as given in a descriptive manual. Identify the species by means of the key.

Bring in other related species, in this case say Hepatica, Thalictrum, Anemone, etc., and note wherein these forms resemble the first species. Identify each one without attempting a full description, but note the common points of similarity which determine family or generic position, and also the points of difference which finally lead to the identification of the species. Later add smiliar comparative studies of other species representing the family, such as the marsh marigold (*Caltha*), columbine (*Aquilegia*), later species of anemones and buttercups, larkspur (*Delphinium*), baneberry (*Actaea*) and other available species.

Of course work with isolated species belonging to smaller families may also be inserted for practice and for comparison with the larger families.

If the work is carried out in this manner few complete descriptions will be made, but many comparative observations should be recorded. The students themselves should extend these comparative observations to fieldwork under proper guidance.

Several families which are represented by larger numbers of species in our spring and summer floras serve admirably for this type of work. The following families are suitable for spring work: The Liliaceae (the Trilliums, dog-tooth violet or *Erythronium,* and bellwort or *Uvularia*) ; Salicaceae (willows and poplars) ; Juglandaceae (walnuts and hickories) ; Betulaceae (birches, hazel, ironwood, etc.) ; Fagaceae (oaks, chestnut) ; Saxifragaceae (alumroot or *Heuchera,* bishop's cap or *Mitella,* mock-orange or *Philadelphus,* and gooseberries and currants) ; Rosaceae (Juneberry or *Amelanchier,* plums and cherries, apples and crabs, strawberries, blackberries, etc.) ; Aceraceae (maples and box-elder) ; and Polemoniaceae (Phlox and Jacob's ladder or *Polemonium*).

The following families are useful for like purposes in summer: Leguminosae (wild indigo or *Baptisia,* clovers or *Trifolium,* sweet clever or *Melilotus,* etc.) ; Labiatae (catnip or Nepeta, the skullcaps or *Scutellaria,* horsemint or *Monarda,* etc.) ; Scrophulariaceae (mullein or *Verbascum,* lousewort or *Pedicularis,* the fox-gloves or *Gerardia,* etc.) ; Solanaceae (Black nightshade or *Solanum,* the ground cherries or *Physalis,* jimson-weed or *Datura,* tobacco or *Nicotiana,* etc.) ; Caprifoliaceae (honeysuckles or *Lonicera,* bush-honeysuckle or *Diervilla,* buck-bush or *Symphoricarpos,* etc.) ; and Compositae (asters, daisy fleabane or *Erigeron,* rosinweeds or *Silphium,* ragweeds or *Ambrosia,* sunflowers or *Helianthus,* chrysanthemums, thistles or *Cirsium,* wild letuce or *Lactuca,* etc.).

This comparative study of related plants leads away from the

old tendency to work out each plant mechanically as a distinct entity, and it gives a better understanding of family and generic characters.

In the selection of material for study care should be exercised that there is no needless destruction of our desirable wild flowers. Trees and shrubs should be used freely not only because of their interest, but because it is possible to secure material for study by judicious and helpful pruning. Branches and twigs should not be broken or stripped for this purpose but should be smoothly cut at the very base. So far as possible the twigs which interfere with others, or which destroy the symmetry of the plant, should be taken.

Weeds and cultivated plants may be used freely. The latter are not included in the ordinary manuals unless they at least occasionally escape from cultivation. Books of the type of the old Gray's "Field-book" contain the common cultivated as well as the native species.

Sufficient material for study may be obtained from among the more common wild flowers either by judicious thinning out where they are very abundant, or by taking only parts of the plants. In no case should the material be taken in needless or wasteful amounts. The formation of herbaria by the pupils should be discouraged. Too much time is thus spent in mere mechanical manipulation, and too many plants are spoiled for the purpose.

Rare species should not be taken, and contests between students and others to determine who can collect the largest number of rare species should be barred.

The indoor work should be extended liberally into the field, garden or weed-patch, where comparative observations may be made without destroying the plants. An exception, of course, may be made with the weeds. Students will find it much more worth while to observe and follow plants in their development than to destroy them. They should be encouraged to visit the same plants repeatedly for this purpose. "Observation without destruction" should be the motto.

In connection with fieldwork students should be taught how to secure material for study with the least harm to the species. They should also be taught how to pollinate the rarer species, and to remove obstructions from the more desirable kinds.

Fieldwork is much more successful if repeated frequently for short periods than if limited to two or three longer expeditions. Such fieldwork may be done along the streets, in gardens and

neglected weed-patches, in nearby groves and along streams and the railway right-of-way. If longer excursions are planned they should come late rather than early in the program, as in the latter case they are sure to be confusing.

The recognition of plants may not only be of great practical value, but it adds an interest to every contact with the living world. It should be a much more widely practiced art.

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