

are the members of this family that no one except an experienced botanist would ever suppose them to be related. Who would ever suppose that the so-called southern moss (*Tillandsia usneoides*, Linn), which grows so abundantly upon the trees of our southern states is classed in the same family as the pine-apple, and yet such is the case. In the West Indies the epiphytic bromeliads growing upon the trees are very abundant and give a characteristic appearance to the landscape. Many of these species look like small pine-apple plants and rest erect upon the branches of the tree, frequently in great numbers.

Another very characteristic bromeliad of the West Indies is *Bromelia pinguin*, Linn., or the so-called "rat pine." The plants are three or four feet high and bear a striking resemblance to the cultivated pine-apples. The leaves are rather broad-toothed and spiny, bright green, but becoming pink and red with age. The flowers are collected into a very dense panicle, are reddish and pubescent. The fruits are separated and are as large or larger than an ordinary plum and have a very acid taste. These plants are used abundantly for hedges, for which they are very serviceable.

Aside from the pine-apple for food, the "rat pine" for hedge, and a number of others for ornamental purposes, the family *Bromeliaceae* is at present of but very little economic importance.

PLANT ECOLOGY IN THE HIGH SCHOOL.

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This paper is limited to that phase of plant ecology which deals with plant societies. A brief survey of the development of the subject will assist in getting a clearer view of this phase as it is applicable to high school work.

It has long been observed that plants grow in well defined societies. It has been noted, for example, that cactuses and yuccas grow in one group, deciduous forest trees, spring annuals and certain ferns in another; while such plants as water lilies (*Nymphaea*, *Nuphar*) rushes and *Lagittaria* former a third group. During the latter part of the last century investigations were begun to determine if possible the causes of these formations.

There have been four epoch making contributions, besides a large number of other valuable papers. The first of these was made by Warming, in 1896. He invented the term "plant societies" and said that they were determined by the water content of the soil. He divided all plant societies into three main classes: the xerophytes, mesophytes and hydrophytes. The salt marshes, according to another basis of classification, were called halophytes.

In 1898 Schimper pointed out the important distinction between edaphic and climatic factors. He showed that latitude, elevation, winds, etc., determined great regional groups, such as arctic tundras, prairies, deserts and forests; while the local variation in plant grouping was due to local or edaphic factors, such as soil, light and slope.

In that year and the year following Graebner published the results of a laborious piece of work. He found that there was a definite relation existing between the physical and chemical properties of the soil and the species which grow upon it.

The fourth and probably the most important of the four contributions was that of Cowles, published in the February and March numbers of the *Botanical Gazette* for 1901, under the title of "Physiographic Ecology of Chicago and Vicinity." In testing the already offered theories he found that they were true, but not sufficient to explain all the facts as he found them in the field.

He found that a peat bog was very different from a river swamp; that the plant societies of a young limestone valley and a young sandstone valley were more alike than those of a young limestone valley and an old one. Such observations as these led him to accept the factors of Graebner and Warming, but also to pronounce them insufficient. After extensive studies in Tennessee, Atlantic coast, Michigan, and his own vicinity, he reached the following conclusions: (1) That plant societies cannot be explained when viewed as static things; (2) that only when viewed as to their origin and life history do they become significant; (3) that, given a temperate and equable climate, their origin and life history are closely related to the physiographic development of a region.

In explanation of this last point it may be mentioned that in a young topography such as the recently glaciated part of northern Indiana, there are xerophytic hills and hydrophytic swamps

and lakes, with a relatively narrow mesophytic region intervening. As the processes of weathering, erosion and sedimentation act on these hills and swamps the topography is brought nearer and nearer to planation and with this change the mesophytic zone becomes broader and broader, while the xerophytic and hydrophytic areas become more constricted. The climax type of a topography is planation, and that of plant formations is the mesophytic society. It may be noticed that as the topography advances from one form to another the plants are displaced by species better fitted to live in the new conditions. In any given location one group is imposed upon another, so that a vertical section showing the plants found in the different stages in its development would give a fairly good key to its physiographic history. These changes are not made suddenly, but are so gradual that in any plant society there are usually remnants of a former condition and forerunners of plants that are to displace existing ones. These societies often lag behind their cumulative causes; for example, when a lake is formed quite a period elapses before a typical lake flora exists. Plants march forward not in confusion, but in well defined zones. These zones have dominating plant which give them color. The middle of a zone is static or nearly so. The border line between two zones, the zone of tension as it is called, is very significant. Here the struggle between species is very sharp. The conditions here are not what they once were. The species which once maintained their supremacy are being crowded out by those which have been living in a similar condition just outside the zone of tension.

With this brief survey of the factors governing the origin and development of plant societies the questions to be considered are: How much of it is good for the high school? Under what conditions can that part be incorporated in the course with profit? How may the subject be presented?

In the high school only the factors worked out by Warming and Cowles in the water content of the soil and the physiographic factor should be considered. The regional distribution is usually included in courses on physical geography. The factor which Graebner proposed presupposes too much knowledge for consideration in a high school course.

Under what conditions is the course feasible: (1) The course

should be preceded by at least one-half year of general botany and enough physical geography to give a clear notion of the physiographic processes. If a knowledge of these laws has not been worked out previously their study will have to be incorporated in the course on ecology. (2) A region must be available where plants grow under natural conditions, as anything artificial disturbs the orderly sequence of societies. (3) A fair degree of skill in the identification of species is necessary. (4) Conditions must be such that the major portion of the time allotted to the subject may be spent in the field. Where the teacher cannot supervise the field work in person it is possible that the work will be done thoroughly only by those who have become intensely interested in their previous study of botany. This argues that it should be made an elective.

How should the course be presented? (1) The class should be divided into sections containing from two to four students. Each group should be assigned a problem and held responsible for it.

In the selection of areas for study the teacher should exercise the greatest care. Level areas over which one set of conditions maintain should be avoided as they are valuable only in a comparative study.

A section along a meandering stream, a bit of lake margin with its adjacent slope, a swamp or pond would furnish an ideal problem, for here the physiographic processes are changing the topography with such rapidity that the movement is easily discerned.

I suggest that the following points be worked out and in the order given: (1) A careful map should be made of the area under consideration. (2) The plants should be listed and their location and relative numbers indicated on the plot. Then the zones, with their characteristic plants, should be worked out, and also the general areas, i. e., the xerophytic, mesophytic and hydrophytic areas. (3) Then the physiographic processes should be considered. Regarding planation as the climax, is the movement progressive or regressive, or, if both are present, in what part of the area is each found? (4) Then to these processes should be related the plant zones. From that time, these zones will not be viewed as static things by the student, but as groups

of species in progressive movement, their line of march being determined and accompanied by the changes in the topography of the region. Finally all irregularities should be worked out and accounted for.

The teacher's aim should be to leave the student with a clear insight into the dynamics of plant distribution.

HIGH SCHOOL GEOGRAPHY

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The lack of definite understanding as to just what geography is, the failure of schools to provide the necessary field and laboratory work, the absence of special geographic training on the part of the teacher, and the notion that any one can teach geography, all lead to the unsatisfactory condition of this science in our high schools. This paper deals briefly with some of these defects, and then presents a few suggestions concerning a one-year course in high school geography.

Successful geography teaching demands that the teacher possess a definite idea of the nature and aim of this subject, yet there is too often the lack of this thorough understanding. Consulting various sources one finds a bewildering difference of opinion as to just what geography is. Yet among eminent geographers of Europe and America there is a fair agreement on this matter. Davis of Harvard, and Dryer of our own state, have been of most service in giving us a definite conception of geography.

Geography deals with man and his physical environment, but the interrelations between man and his environment are not the whole of the subject. The mutual relations among the various elements of this environment are an essential part of it. The relations between man and earth cannot be intelligently understood until the relations existing among the elements of environment are grasped. These elements can be grouped under relief, climate, and plant and animal life; and the mutual relations between relief and climate, and between relief and climate on one hand and plant and animal life on the other hand constitute the first half of geography, which is physical geography or physiography. The second half includes the mutual relations between man and his material