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INTRODUCTION TO
PLANT ECOLOGY

*A Guide for Beginners in the
Study of Plant Communities*

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PART I

Introductory

CHAPTER I

What is Ecology?

THE word ECOLOGY, as is well known, is derived, like the common word *economy*, from the Greek *oikos* (*oikos*), *house*, *abode*, *dwelling*. In its widest meaning ecology is the study of plants and animals *as they exist in their natural homes*; or better, perhaps, the study of their *household affairs*, which is actually a secondary meaning of the Greek word.

In this book we shall confine ourselves to plant ecology. For various reasons it is more developed and more readily accessible to the beginner than animal ecology. The latter is often not easily attacked without some considerable knowledge of the vegetation, because very many animals depend directly upon plants for shelter, while all depend upon them, directly or indirectly, for food. Plants form the basis of all life as it is lived upon the earth, because they alone have the power of making organic substance from inorganic, of building up living substance from materials like carbon dioxide, water and mineral salts. Animals can only use the results of this work of plants, either by directly eating them (herbivorous animals), or by eating other animals which have fed upon plants. In a favour-

able climate and soil plants cover the ground more or less completely, thus forming a natural framework or basis for the study of the living populations of the globe. In this way they determine not only the food but largely also the shelter and general conditions of life of the animal and human communities.

In its widest sense ecology must cover the study of the "household affairs" of animals, including man, not only because animals form an important part of the life existing on the surface of the earth, but because the effects of animals upon plants are numerous and far-reaching; while man of course occupies a unique position owing to his far-extended control over nature. Thus anything like a complete study of the ecology of a plant community necessarily includes a study of the animals living in or feeding upon it. The influence of man upon plant communities is of first importance in all but the uninhabited and the most sparsely inhabited regions of the earth. As we shall see in later chapters, we can never afford to lose sight of past and present human activities in their effects on the vegetation of countries which have been long inhabited and densely populated, like those of Western and Central Europe. But though we must thus constantly take account of the effects of animals upon plants, we shall here be concerned entirely with plant ecology—our centre of interest will be the plants themselves.

It is clear that in the wide sense defined above, plant ecology cannot properly be considered a separate branch of botany, since it must include a great number of topics which certainly belong to the older, well-recognised divisions of our knowledge of plants. Thus, if we are going to study the household affairs of plants as they grow in nature, we must first of all learn to distinguish the different kinds or species of plants with which we have to deal, and for this purpose we must have some knowledge of *taxonomy*, or, as it is often called, *floristic botany*. To this we must add some knowledge of *genetics*, the modern science of heredity and variation, on

which depend the origin and maintenance of existing "taxonomic units." Then we must understand the construction of the plant body, the differences between its different members, how they grow from the seed or from one another—and this is a part of *morphology* or *organography*. Further, we must know something of the *minute anatomy* or *histology* of plants if we desire to penetrate at all deeply into the reactions of plants to the different environments in which they grow. Again, we must study how far plants depend on insects or the wind for fertilisation, or how far they fertilise themselves, the ways in which they spread from place to place, the means by which they propagate themselves and are dispersed (fruits, seeds, rhizomes, runners, etc.). All these last-mentioned topics used to be included under the name "biology," or "bionomics" of plants, but the former name should be restricted to the science of life as a whole, and the latter, which was more frequently used by zoologists, is now generally replaced by the term ecology. Finally, every attempt to ascertain the actual causes that underlie the ability of some kinds of plants to flourish in particular situations, while others cannot, will certainly lead, not only to questions of the means of dispersal already mentioned, and of the influence of animals and of human activity, but also to a study of soil (*pedology*) and climate (*climatology*) in their relation to different species. These last investigations lead directly to a study of the physical and chemical relations of the plant to its habitat, involving some of the most difficult problems of *plant physiology*, problems which occupy the attention of many of the ablest specialists.

Thus it becomes clear that plant ecology in the wide sense is more a means of approach to a large part of detailed botanical study than a name for a special branch of the subject, such, for instance, as histology (the study of tissues), cytology (the study of cells), or, again, the study of a particular group of plants like the mosses or the fungi. Alternatively, it may be regarded as a synthesis of the special knowledge obtained by the study of particular departments of botany in

RELATION TO THE LIFE OF PLANTS IN THEIR NATURAL HABITATS.

It is important to emphasise this fact because the modern popularity of ecology depends largely upon it. This popularity represents a reaction from the kind of botany which dealt only with plants in narrowly defined aspects, such as the study of anatomy, of physiology, and of the different groups of the plant kingdom. That sort of study is most conveniently pursued in laboratories to which the plants to be studied are brought, and much of it can only be carried out with the aid of laboratory equipment. The result of the too exclusive pursuit of laboratory work is to remove the student altogether from plants as they actually live in their homes; and in the absence of continual contact with plants in nature his knowledge becomes curiously limited and one-sided, though it may be profound within its limits. Occasional field excursions do not suffice to correct this tendency, for even when taken seriously, (which is not always the case) they are almost always limited to collecting and naming the species met with—there is rarely time for anything more. *Ecology must be studied primarily in the field*, though it is often desirable or necessary to continue in the laboratory the investigation of special points which cannot be decided without books, microscopes, or laboratory apparatus.

A parallel may be found in the study of man. The human anatomist and the human physiologist have, each in his own sphere, a profound knowledge of man, and the two together can give a fairly complete general account of the structure and working of the human body. But no one would contend that such knowledge covers the field of what we may know about man and his activities. It is not sufficient to study the structure of his dead body in the dissecting room, or the functions of his organs and tissues in the physiological laboratory. To learn what man actually is and does in the world, we have to go out into the world and study him as he lives and works among his fellows. And the same is true of plants.

Plants are gregarious beings, because they are mostly fixed in the soil and propagate themselves largely in social masses,

either from broadcast seed (or spores), or vegetatively by means of rhizomes, runners, corms, or bulbs, sometimes by new shoots ("suckers") arising from the roots. In this way they produce *vegetation*, as plant growth in the mass is conveniently called, and this is found to fall naturally into *plant communities*, or *units of vegetation*. Now these plant communities have structures, activities and laws of their own. Each has an internal economy depending on the relations of its individual members to one another; also an origin, history, and fate. Particular communities can exist in some places and not in others, depending on the conditions of soil and climate and on their relations to other plant communities and to animals. Within the larger communities smaller ones exist. In these features we recognise parallels with the nations, tribes, and societies of mankind, though the members of plant communities are not so closely knit as the members of human, and even of the higher animal, communities, by a complex physical and psychological interdependence. Plant communities are also essentially different from human communities, in that they are commonly composed not of a single species of organism, but of several or many different species living together.

The main causes of the specific structure and individuality of a given plant community are: first, the fact that only those species can be present in it which exist in the particular part of the world, and which are able to reach the particular spot; secondly, that only those can be present which are able to exist under the given conditions of life, and in competition with the other species present; and thirdly, that in many communities certain species can only survive in the presence of others, for instance the "shade plants" of a forest floor under the trees which cast the shade.

The systematic study of plant communities is on the whole a modern study, though types of vegetation and their dependence on conditions of life have been recognised for a long time. The active modern study of these types is, however, only about half a century old. In Great Britain especially "ecology"

has tended to become identified with the study of plant communities, because both the general use of the name and the organised study of communities were largely determined by the publication in 1896 of the German edition, entitled *Ecological Plant Geography*¹ of the pioneer work² by Professor Warming of Copenhagen. This identification is not, however, justified. As we have seen, ecology in the wide sense is much broader. *Synecology*, from the Greek *σύν*, *together*, is often used for the study of communities, as distinct from *autecology* (Greek *αὐτός*, *self*, *by oneself*, *alone*) for the study of the ecology of individual species. Modern Continental workers, and they are being followed by many American authors, now generally use the term *plant sociology* for the study of plant communities as such. They confine the word *ecology* to the study of the *habitat*, the *oikos* itself, of a plant or of a community, i.e. of the sum total of the effective conditions under which the plant or community lives in a given spot. This is certainly a strictly logical use. Nevertheless, in this book the word is employed in the wider meaning at first described, for it is important, especially in a book intended for beginners, to keep the emphasis on ecology as the approach to botany through the direct study of plants in their natural conditions. In this approach a knowledge of plant communities, their structure, economy, origin and fate (plant sociology) must bulk very large.

Ecology in this wide sense is of the greatest importance in schools, because from the outset it introduces the pupil to plants as they actually exist, and to the parts they play in the world, and avoids the narrow one-sided ways of looking at plants that the older-fashioned methods of teaching botany, if pursued alone, tend to develop.

¹ *Lehrbuch der ökologischen Pflanzengeographie*, Berlin, 1896.

² *Plantensamfund: Grundriss auf den ökologische Plantogeografi*, 1895. "Plantensamfund" is roughly equivalent to "Plant Communities."