PLANT ECOLOGY AND NATURAL AREAS

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It was seven years ago, almost to the day, that I was introduced to Mettler's Woods. After a tour of exploration with Dr. Buell, we sat on a log enjoying the woods in its fall coloration and inevitably talking of what it could mean if this virgin forest could be preserved.

For myself, I was only daydreaming with little thought of reality. I'd been through this kind of thinking several times before because of an interest in and an occasion to work with virgin forests in several parts of the United States. In at least three widely separated areas such forests which I studied were destroyed by lumbering a year or two later, usually because of a change of ownership. Much as the academic scientist would like to preserve examples of our original vegetation, his economic environment and resources hardly permit any effective competition when there is an industrial or economic factor involved on the other side. The more valuable the forest is for lumber and the easier it is to exploit, the more certain it is that the price will eventually be too high for an owner to resist. The same applies to grassland, especially if it is located in a highly developed agricultural area. Thus, in recent years, our few remaining examples of original vegetation which are near industrial and agricultural centers have disappeared at an accelerating rate. When they are once destroyed, they are permanently gone.

To be sure, federal and state agencies have taken over great acreages which include virgin vegetation, and these are available as recreational areas and for scientific study. But these agencies have slowed down on land acquisition and it is obvious that the administration and protection of small isolated tracts would not be attractive to them. Their support for preserving an area like Mettler's Woods is not common.

Again, universities are peculiarly unsympathetic to the acquisition of out-of-door laboratories. A number of institutions do have considerable acreages under their control and Duke University with 7,000 acres of forested land adjoining its campus is somewhat unusual in this respect. But almost invariably these acreages are the result of fortuitous circumstances rather than of a deliberate plan. In recent years we at Duke have been unable to sell the administration on purchases of other acreages, regardless of their biological importance. I know of similar instances elsewhere and I suspect that such opposition would be found rather generally.

These were the thoughts which accompanied my daydreaming that pleasant October afternoon seven years ago. But, because several people decided this need not be a dream and were willing to give countless hours to selling the idea to others, Mettler's Woods has been saved and we are here to celebrate that fact.

Many of you have undoubtedly contributed to the funds which made the purchase possible and, better still, gave support for the immediate

initiation and continuation of ecological investigation. Already graduate students have come here with the express purpose of initiating studies of the woods. It is not necessary, therefore, to sell the idea of preserving the woods. Its very uniqueness is almost sufficient to justify its preservation as a kind of living museum. This probably influenced donors who may have had but a vague idea of the kinds of studies which might be carried on here.

It is not my intention to spell out the kinds of work which will be done here. Rather, I would like to present some ideas which might help to explain the interest of plant ecologists in any natural area.

Before doing this it seems worthwhile to emphasize certain advantages peculiar to Mettler's Woods. Many protected natural areas are actually used relatively little for scientific research for the simple reason that they are remote from research centers. Thus the investigator must raise funds for transportation and subsistence under any circumstances. Sometimes the remoteness is such that there are no living accomodations, and there may be such a degree of inaccessibility that work is practical only in the summer months.

Intensive ecological studies require more than periodic observation restricted to summer, and so Mettler's Woods is ideal for such work. being easily accessible, near to a research center, and available for study in all seasons with continuity of observation assured from year to year.

Now, why is the ecologist interested in natural areas; what uses can he make of them? You all are aware that ecology is concerned with organisms in relation to environment. This means, of course, that the ecologist must know the organisms—not just what they are, but how and when they reproduce, the conditions under which they survive, their tolerance of each other and competitive abilities, and all the many factors of the environment which affect them. This provides an almost unlimited number of possibilities in the way of ecological research because we would like to know about all the operating factors in the environment, all the requirements of all the organisms, and finally how the organisms and the environment are inter-related.

But this is not very helpful in clarifying the ecologist's objectives. I am, therefore, going to draw a parallel which may be useful to anyone who is interested. A large segment of plant ecology has come to be known as "plant sociology" and, in fact, by some the expressions are used synonymously. At first glance, this may seem curious, in view of our usual conception of sociology. But it is no more so than the recent trend toward labelling certain types of studies of man as "human ecology."

A dictionary definition of sociology says, "it deals with the origin and evolution of society, or of the forms, institutions, and functions of human groups." This applies equally well to the phases of plant ecology which are concerned with natural vegetation and the groupings of species into plant communities. I can think of no better illustration than the analogy used by Dr. W. S. Cooper, a former professor of mine, and I shall therefore use the idea here, although the details may not be as he expressed them.

The settlement and colonization of our country only a few years ago was characterized by a pattern of events, repeated again and again. Each area was visited first by explorers in search of something new and different; willing and able to live off the land and undergo any hardships to satisfy their curiosity. Their reports on their routes of travel, of the game and climate, brought trappers and hunters. They too were self-sufficient and happy in their isolation, but their objectives were different and they stayed so long as there was game for food and the pelts which they sought. Now, as a natural result, trading posts were established and these, in turn, became centers to which less nomadic pioneers headed when in search of new land for cultivation. They brought families and some agricultural equipment and settled in the vicinity in the hope of greater fortune and with the intention of permanent residence.

By now the explorers had long since moved on, and the trappers and hunters soon moved too since they considered the country crowded when they found a homestead in a favorite valley and land being cleared or broken wherever they turned. This was the vanguard of civilization to them and they would have none of it.

Meantime, where several permanent homes were established there were always some settlers with special skills who were sought out for help with particular jobs. Independent and self-sufficient as the early settlers might be, an interdependence soon developed as special skills were exchanged. There were those, for example, who were proficient in repairing wooden wheels and setting their iron rims; others had a gift for diagnosing and handling sick animals; and still others became experts at midwifery. Thus, a dependence upon one another was a natural development and as the communities grew these gifted folk automatically became specialists when they eventually had time for nothing else. Of course, over all there was a co-operative assistance in times of emergency, such as Indian uprisings or epidemics, which represented the beginnings of community structure.

At the same time there was further introduction of specialists which further divided responsibilities and resulted in greater interdependence. Banks became necessary as barter became too complicated; churches and schools grew up in every center of population and this necessitated clergy and teachers; bars required bartenders; law enforcement became a community rather than a personal concern and was turned over to a sheriff. Thus there came a division of responsibilities and an interdependence which became more complicated and less avoidable as the communities grew.

To be sure, not everyone made constructive contributions in the system. There were dependents of various kinds as there are today among the human population, and there were parasites—like gamblers, e.g. Then too, there were other lesser organisms in these categories—disease organisms, rodents in fields and homes, and undoubtedly termites in wooden foundations. Leavening the entire system was the competitive drive of the individual who sometimes sought to accumulate material things—a washboard for his wife, glass in the window of his cabin, or horses instead of

oxen for himself; sometimes the ambition was for education. a white-collar job, or even a political appointment. As the communities became more complex certain individuals became the dominants in various fields. controlling or influencing the thinking and procedures of many others, less aggressive or less qualified. At the same time man progressively moved toward management or control of portions of this environment. He could move from a stream or spring if he dug a well, go still further when he acquired a pump. This, of course, has gone on right up to the present with irrigation, solar heating, and air conditioning to illustrate the point.

The various communities that grew up expanded for various reasons and at different rates. The sociologist and the economist could elaborate on this at length. Some communities stagnated and disappeared, others became our large cities of today, and some, changing slowly, have enlarged but little. Always change was characteristic, sometimes rapid and dramatic, and sometimes there were periods of depression when change was hardly noticeable; sometimes catastrophe struck and floods, epidemics, or economic circumstances altered the course of events in marked fashion. Today we are all aware that we are in a stage of extreme modification of the structure of our human communities as a result of an expanding population and economy.

Through prehistoric and historic times we have evidence that communities and civilizations have gone through such developmental processes and that some mature communities have disappeared as climates changed; others have stabilized at a high level of integrated dependency; others have become over-populated and given rise to major migrations.

All these characteristics of human communities are closely paralleled in natural communities. The chief difference is that plant communities and their sociology are controlled by natural laws and the organisms cannot make adjustments as can man to compensate for, to ameliorate, or to use the natural phenomena around him. Thus, in a given set of conditions, natural communities, if unhampered by man, undergo a pattern of development that repeats itself with minor variations. If that pattern can be deciphered in terms of particular or general environments, the development and eventual structure of other communities can be accurately predicted. Furthermore, the responses of natural vegetation in various habitats may be highly indicative of the potential of those habitats for men's use.

Briefly, to illustrate, any bare area, large or small, is a frontier or a new land to plants. Sometimes the environment is so extreme that no more than the accidental wanderer gets into it and then it may not survive. More often a bare expanse will be colonized first by hardy pioneers—often annual weeds that have found their way to all parts of the world. Then come the more permanent settlers—biennials and perennials—aggressive and highly competitive. When they take over, the earlier pioneer annuals disappear, but the forerunners of a more complex community soon come in. Where the climate will support forest these are shrubs and tree seedlings (equivalent to bankers and shopkeepers). Already, competition is playing a part in the selection of species which will be successful here and

the probable nature of the ultimate community on this site may be indicated. Certain species may have the ability to meet the competition of all others and they will become the dominants, others unqualified to live in a many-layered forest (skyscraper existence) soon disappear. Still others survive in or may actually move into the developing community as parasites or dependents. Should the tree seedlings become well established they might grow up into dominants at maturity and control the situation for a considerable period of time. But in many forested areas, as in developing cities, there is still *big business* with mergers and stock splits to be reckoned with. This first forest, of relatively simple structure (shopkeepers) is usually replaced by a much more elaborate combination of species whose inter-relationships are as delicately balanced as those of interlocking holding companies, union and management, or even political parties.

Now the plant community is as complex as any highly organized urban center and the whole has reached a stage of dynamic equilibrium whose general characteristics are determined by the over-all climate and whose specific nature may vary with the particular habitat. Individuals may disappear but the organization remains much the same, as replacements of the same kind take over where old hands leave off.

In plant sociology such a community is termed the "climax"—so called because it represents the climax of vegetational development and also because it is the ultimate community to be expected under the conditions of climate for the region. In a climax community the species are so adjusted to each other and the environment that, so long as the over-all climate remains the same, the general character of the community will remain unchanged.

We have emphasized that climax vegetation is preceded by a sequence of changes in dominants which is called plant succession. It should be pointed out that, as with the development of cities, plant succession varies with the habitat in which it is initiated. Unlike the development of cities, however, plant succession in similar habitats follows the same trend because it is controlled by natural laws. It is, therefore, predictable. Also, regardless of the initial habitat, all successional trends within a climatic area are in the direction of climax.

Potentially then one could reason that a climatic region might eventually be clothed with the same vegetation throughout. Actually, this never happens because of differences in rates of successional trends as modified by soils, physiographic irregularities, and erosional processes. Extensive areas are rarely blanketed by continuous and uniform climax vegetation. Catastrophic events like hurricanes or fire also occur periodically and if the vegetation destroyed is climax the successional processes are set back to start over again at a point in the trend determined by the damage to vegetation and the modification of habitat. Nevertheless, some climax vegetation was always well developed locally before man became so marked a factor in modifying natural environments and vegetation. Mettler's Woods is the nearest to an example of the climax existing in this area. That such an example is available and that it is virgin forest, essentially unchanged by man's activities, makes it doubly valuable for ecological studies.

We know the history of our big cities but if we were to attempt to explain their origins and development, why they started where they are, why one grew and another disappeared, how they function and what keeps them going, we would want to know all about the contributing factors. We would want to know about the climate, the soil, the original vegetation, the transportation facilities, what the government was like, the products produced, etc., etc. All these would contribute to our understanding and would be involved in the sociological interpretation of such a city.

In plant sociology we seek the explanations of vegetation as it occurs. The history is not recorded, it must be dug out from all possible natural sources. The causes of vegetational responses to environment must be ferreted out and often this involves intensive experimental studies of individual species in all phases of their life cycles. To interpret responses of species we must know in detail what the components of the environment are like. This means measurements of such factors as soil, water, air, temperature, and light in every kind of habitat and again it must be known how the inter-reactions of these factors affect the organisms.

It should be apparent that, in an area disturbed by man, there could be many examples of successional communities in various stages of development. These are useful to the ecologist but to complete his observations he must also know the characteristics of climax vegetation, preferably in virgin condition. This is the point of reference with which to compare and evaluate all other developing communities.

Now again we can emphasize the potential usefulness of these woods and similar virgin vegetation preserved for study in areas where industry and agriculture have virtually eliminated climax vegetation. Even small tracts can be very valuable when their preservation is indefinitely assured. Studies can then be planned for any season and over as extended periods as seems necessary without concern about losing everything to the vagaries of ownership.

Now, for those of you with a persistently practical turn of mind, it should be pointed out that studies of virgin forests or of any natural area may have applications that affect all of us, directly or indirectly. We may here logically restrict ourselves to forested areas. If the principal successional trends and the climax with its variations were well known for a region and all the causes of succession were clearly understood, there could be tremendous practical advantages. Natural vegetation is one of the best indicators of potential land usage under management, and ecological knowledge is increasingly being used in applied fields. In forestry particularly the professional is usually well-grounded on ecological principles which he uses constantly along with his knowledge of the ecology of local vegetation.

When the habitat requirements of a species are known it is obviously foolish to expect big returns from plantations in circumstances differing markedly from natural environments. If a species is known to predominate in a state of succession preceding the climax, a planted stand of it will have to meet the competition of invading species characteristic of later stages of succession. The cost of keeping down this competition will have to

be considered against the desired yield. Species of trees which grow in pure stands in natural circumstances can be expected to do well in plantations, but those which are subordinate in a forest, possibly requiring shade for establishment, will do best in combination with others. These are but a few generalized suggestions of the kinds of applications which can and are being made.

The principles of natural succession do not break down under forest management (or in agriculture or grazing). When it is economically feasible management practices are kept closely in line with natural vegetational changes because these will happen anyhow, or will have to be counteracted. The greater the deviation from natural change, the greater the effort required to control it. The climax forest would thus seem to be the most desirable one in the way of management. But more often than not the species of the climax are not the most valuable for lumber and are usually, in addition, too slow growing to yield in proportion to successional species. Nevertheless, an understanding of climax and its relationships is fundamental to understanding the ecology of all other types of vegetation for the area.

Thus studies in this Hutcheson Memorial Forest will probably not lead to the encouragement of great acreages similar to it. Rather, they will give a greater understanding of the communities which must have preceded it and thus of the successional phenomena characteristic of this area. This kind of research is fundamental and where it has been done elsewhere the applications have amply justified the effort. As I said, these last remarks are made for those who have a persistently practical turn of mind. Almost invariably fundamental research eventually leads to applications. The ecologist is not usually concerned with applications, but at times it is comforting to see phases of one's work applied directly in some applied field.

The saving of this forest and the opportunities it creates for research, now and in the future, will almost certainly be applauded even more in the future than it is today. Those who have made it possible have the appreciation of ecologists everywhere, plus a reasonably high assurance that what is learned here will have significance for all who are involved in managing biological phenomena.