THE PLANT ECOLOGY OF THE ROCK RIVER WOODLANDS OF OGLE COUNTY, ILLINOIS.

H. DE FOREST, UNIVERSITY OF CHICAGO, 1920

INTRODUCTION

Ogle County is located in the northern part of Illinois in the second tier of counties just west of the center line of the state. It is an irregular parallelogram in outline, some 39 miles in its widest west-east and 29 in its north-south direction. The total area is about 750 square miles. The area dealt with specifically in this paper comprises some 75 to 80 square miles along the Rock River, with a small area to the west of the Rock on Pine Creek.

The larger part of the surface of the county is overlaid by glacial drift, generally so thinly as rarely to attain even 20 feet depth, and reaching its maximum of about 125 feet only in the northwestern part. The elevations above sea level run from about 700 to 900 feet. The Rock River, a moderate sized stream, takes a general north-east to south-west course through the middle of the county, with three or four main tributary streams entering it from the west and the east. It makes a great bend near the southern border of the county. The course of the Rock takes it through Iowan drift, which overlays more than half the county and affords good drainage without swamps. From the southern boundary an irregular area, varying from a few hundred feet to 10 or 12 miles wide, underlain by St. Peter's sandstone, extends northward along the Rock on either side for about two-thirds of the distance to the northern boundary. The remainder of the county, with the exception of a small area of the sand-stone at the west boundary and some shales at the south-east corner, is underlain by Trenton-Galena limestones. Outcrops of both sandstone and limestone in cliffs and walls occur along streams.

The larger part of the county is undulating prairie. Here occur groves of upland prairie oaks. Along the river and creeks the country is more or less hilly. Here there is a fair growth of woodlands.

ROCK RIVER

The Rock River, rising in southeastern Wisconsin, has a course of some 300 miles, flowing southwestward to empty into the Mississippi River below Rock Island, Illinois. It has a drainage area of about 11,000 square miles, half of which is in Wisconsin in the Wisconsin glacial drift, affording poor drainage with the occurrence of many swamps, and half in Illinois in the Iowan glacial drift, affording good drainage with no swamps.

The course of this river has been greatly altered since the Pleistocene ice age. Its former valley is much to the east of the present one in Ogle County. The preglacial valley is departed from in Winnebago County before reaching Ogle County, but in Ogle the river takes its way along the valleys of certain of the preglacial tributaries and in large part along a postglacial course. Thus the Rock follows the preglacial valley of the Leaf River for a few miles in the vicinity of Byron in the north of the county but in the reverse direction from that of the preglacial Leaf, and uses as well some of the small preglacial tributaries. Farther south Kyte River flows northwestward into the Rock below the town of Oregon in the valley of a preglacial western tributary of the Rock. The head of this is in the hills back of the town of Oregon, the present Rock cutting off only the headwaters portion of the preglacial valley. Several smaller streams also had preglacial courses cutting across the present Rock River which now intersects several of them midway of their course and diverts them westward into the Mississippi River by way of the Rock. From not far south of the Kyte the Rock appears to follow the line of a small preglacial stream as far as the mouth of Pine Creek, in a valley varying from about one quarter of a mile to as much as a mile in width at Grand Detour where the river makes its big bend. The course of the Rock, then, from where it turns away from its broad preglacial valley in southern Winnebago County, is in Ogle County southwestward through a much narrower valley, a valley that is postglacial except where the Rock occupies the valleys of preglacial streams. In this postglacial course the river is about 500 feet wide in a valley varying from 1000 feet

to 1 mile in width. Its total fall in Ogle County is only some 50 to 60 feet. It is this narrow portion that has given rise to the river bluffs.

At Byron there are deposits of glacial gravel some 50 feet above the low water level of the Rock. At Oregon such deposits also occur, being some 40 feet here, and they extend thence to the southern end of the county and beyond. Remarkably small excavation by the river has taken place since the deposition of this gravel. The rock excavation has been interglacial and the gravel excavation postglacial, the period of the rock excavation having been the longer and for the greater part in limestone. Today the outcrops seen along the Rock in Ogle County are mainly St. Peter's sandstone, which outcrops for some 14 miles in banks from 25 to 200 feet in height. It is this that forms the bluffs for some two and a half miles above the town of Oregon, near the middle of the county, to below Grand Detour at the southern end. In color this sandstone is from nearly white to golden yellow and dark brown, from the iron once held in solution by the water. Sometimes these bluffs are capped by limestone, as on the east side of the Rock north of Oregon where the Black Hawk statue stands. Liberty Hill, west of Oregon, is also of this sandstone capped by limestone. A few miles north of Oregon, and south of the mouth of Pine Creek near the southern boundary, the outcrops rapidly decline. In the St. Peter's sandstone there are sometimes ferruginous layers which, being more resistant to erosion, are often left as brown to almost black parallel or circular ridges. This is well shown at Hotel Rock, on the west shore about four miles south of Oregon. Again the sandstone may occur as an almost white, non-ferruginous variety, consisting of almost pure silica, as at Castle Rock on the west shore just north of Hotel Rock, where the stone is soft, friable, and very porous. In the ravines about the town of Oregon buff limestone occurs, and it is this that caps the sandstone of the river bluffs upon which the statue of Black Hawk stands opposite Oregon. Certain creeks emptying into the Rock show St. Peter's sandstone at their mouths, then, farther up stream, the buff limestone, and still farther up blue limestone, and finally Galena

limestone as a rock wall, this last being dull gray to cream color, coarse-grained and porous. It is the Galena limestone that forms the bluff at Pine Creek upon which grows a stand of white pine. The above limestones, belonging to the Trenton group, are sometimes referred to as the Trenton-Galena limestones.

The Rock, on the whole, may be considered as, even in the preglacial beds, an immature postglacial river, since some erosion has taken place since the glacial period. Considered thus it is in the second phase of river development, that of bluffs, with erosional and depositional banks at various places. In this mid-phase of river development there frequently occurs an overlapping of bluff and flood-plain, and this is seen in the Rock. It should be noted, too, that much of the flood-plain development is artificial in nature, due to the formation of sand and gravel bars after the breakage of dams, as at Oregon and Grand Detour.

It will be seen that the region is one altogether of the varied physiography of a river in its mid-phases with an accentuation of the topography in many places owing to the older preglacial parts. The soils belong to the following classes of the five recognized by the State Soil Survey. Upland timber soils, the yellow to yellow-gray loams. Residual soils, including stony loam and rock outcrop. Terrace soils, which include bench lands (second bottom lands, formed by deposition from overloaded streams during the melting of the glaciers). Bottomland soils, which include the overflow lands or present flood plains along streams, and other poorly drained lands. The last class includes swamp soils elsewhere in the state. There are, however, no swamps in Ogle County. The remaining soil class, outside of the region especially under consideration in this paper, is that of the upland prairie soils, in the main the brown loams. These are rich in organic matter and are said to have been covered originally with prairie grasses, whose partly decayed roots have been the source of the humus. The upland timber soils are said to include practically all of the upland that was formerly covered with forests. The question raised thus, as to whether the vegetation caused these soils to be-

As well as may be ascertained today the original areas of woodland, about 1840 and for an indefinite period before then, were approximately as represented on the map issued by the County Superintendent of Schools about 1900. The singular fact that these wooded areas should remain about the same in extent for over half a century is said to be explained as follows. During the years 1840 to 1900 the nature of the woods underwent great change at the hands of the whites. During this time a haphazard selection cutting rather than actual clearing is what prevailed, desirable species of trees of large size being cut out promiscuously. From about 1880 to 1900 actual clear cutting was more notably under way, but this was of such a degree that it did not become strikingly noticeable until about 1900. From this date onward, however, the clearing became great until very recent years, along with further selection cutting, the latter still going on. Today Ogle County has over 30,000 inhabitants. About 5% of the land in the neighborhood of the Rock may be estimated as wooded. A recent estimation for the northwestern part of Illinois of 8% may serve for rough comparison.

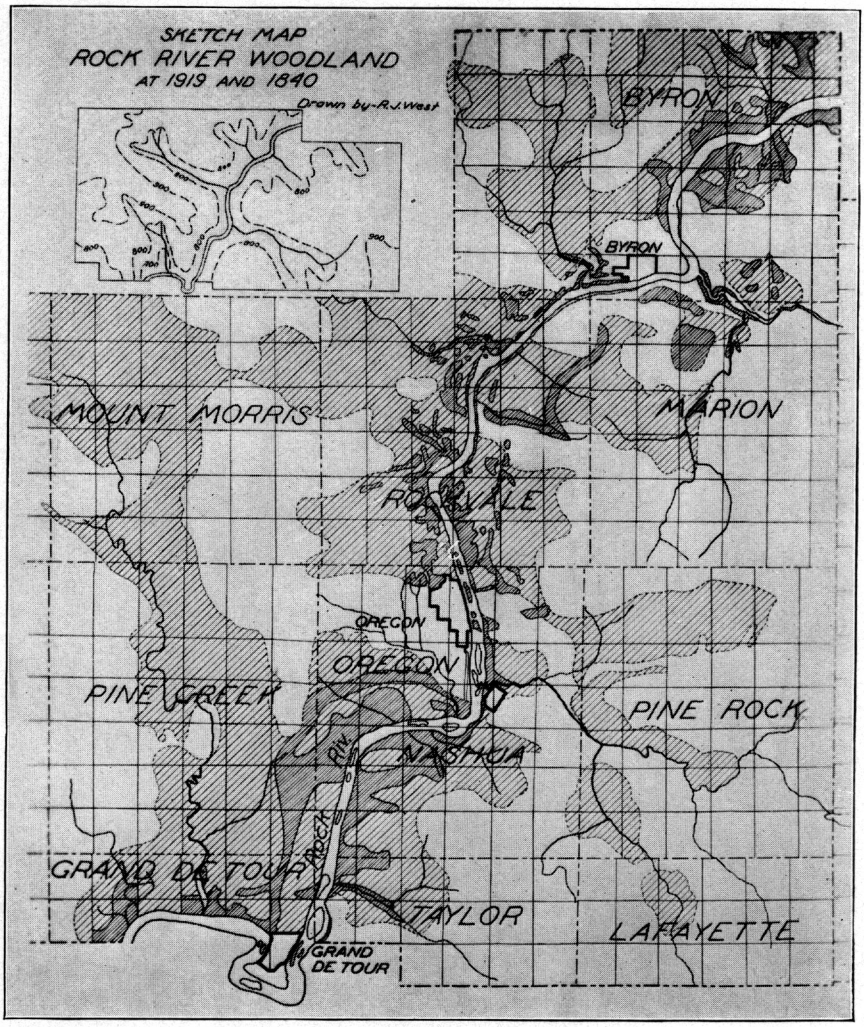
THE VEGETATION

The Rock would probably be referred to as a prairie river located in the grasslands (prairie)—deciduous forest transition area of North America. This transition belt, as is well known, possesses characteristics, in the species of plants present, of the deciduous forest area to the eastward and of the grasslands to the westward. The prairie areas of this transition belt comprise the major part. Its affinity with the east is expressed in the woodlands along streams and extending out irregularly from these. Although Ogle County lies in this transition a more exact delimitation of ecological boundaries takes note of what is known to plant geographers as the prairie peninsula. This is an arm of grassland extending eastward into Illinois and adjacent states. It grazes Ogle County at the south.

Further, while the above statement holds good in a general way, the Rock River woodlands are not thoroughly typical of the prairie river. In some respects they are more representative of the eastern portion of the transition belt.

Thus the wooded area on either side of the Rock, in its original extent, was about equal. See the sketch map on page 160. In the typical prairie river wooded region the greater extent of the woods is on the west of the river. The potential mesophytism, if not the actual mesophytism, is greater in degree and in extent in the Rock River woodlands region than in that of any true prairie river. An examination of the Rock in Ogle County shows that the intrenched valley must expose here on either sloping side a set of soils that is different from the prairie soil. This is typical of the middle and lower courses of the prairie rivers. In general, too, the east side of the valley is wider than the west side, and the east is also generally of somewhat lower slope. This, again, is typical of the prairie river. On the Rock River this is locally greatly broken into an account of both the preglacial character of much of its course in Ogle and the physiographic diversity of the postglacial portion, so that the statements hold true only for the general aspect of the entire course in the county.

In part this transition belt is a savanna. This term is often used in order to compare it with other similar areas of the world that go by this general name. Many parts of this North American transition unquestionably furnish examples of true savanna, chiefly of the patchy type, where, in a grassland, patches of tree growth frequently occur. This is almost the same thing as the "oak openings" often mentioned in literature descriptive of the early days of settlement, with the possibility that the oak openings comprised rather more frequent wooded portions than characteristic patchy savanna. In some places the park-like savanna occurred. Here the grassland was set not with patches of tree growth but with isolated trees far enough apart to make it possible to drive about through the area. The early records of Ogle County make reference to such a form in Mount Morris township and the reference makes it highly probable that this example arose as the result of prairie fires. Other examples must have existed and there is likelihood that prairie fires were an important if not decisive element in their creation.



ROCK RIVER WOODLANDS

Showing their original extent, based on the map issued by the County Superintendent of Schools in 1900, and on field sketches by the writer in 1919.

The Rock River Woodlands are the vegetation response of this particular part of the world to the conditions of inland plant succession in the depressions of the erosion topography of a river system that may be considered, in general at least, as in its mid-phase of ravines, bluffs, and flood plains. A varied assortment of habitats for plant life is a corollary. Early xerophytic ravine stages through to extremely mesophytic late ones in both clay and loams are present, with the rock bluff phase of river action in sandstone and limestone, the depositional phase of flood plains, and depositing and eroding shores. This is the structure that has already been described as the Rock River system in Ogle County, with its vegetational history as already briefly outlined. Further, into all this there has been projected an element of powerful effect in the changes wrought by it directly and indirectly on the topography and the vegetation. This element is that of the various activities of men. It is in its effects from minor to cataclysmic and from slow to the swiftest of all factors.

FACTORS OF THE COMPLEX

In the chains of causation leading to certain effects it is customary today to stress particularly the physical and chemical alterations in the surroundings, that is to say in the kinds and the rates of processes making up the conditions under which things exist and change. From the scientific standpoint this is, of course, desirable since it is always the more fundamental that is needed for establishing principles of application that approach universality. Today, however, the whole story, so to speak, of many occurrences in nature cannot be expressed in physical and chemical terms. The development of vegetation, for example, cannot possibly be told in such terms alone, whatever may be possible at some later time. An account of the plant ecology of any locality must necessarily use other means of expression also. So, for a qualitative investigation of vegetation, an artificial classification of the "factors" or elements of the different complexes involved is desirable. A common, very general one, of great use in the past but now somewhat outworn, is the division into topographic and biotic factors. Another recognition of this is to be seen in the still very use-

ful though purely artificial separation into 1) Primary Succession; that resulting from natural causes, and 2) Secondary Succession; that resulting from disturbance by man. This is wholly a classification of convenience. The different categories may, in many cases, overlap considerably in so far as the laws of physics and of chemistry are concerned. But this is of no great importance in a qualitative investigation. Nor need it interfere at all with quantative investigation of vegetation, where an endeavor is made to seek out physical and chemical relations in plant life or to advance our present defective state of knowledge concerning quantitative methods of investigating such phenomena.

A simple classification of convenience for the purposes of the qualitative investigation in hand is as follows:

Activities of men,
Climatic fluctuations,
Fires,
Plant diseases,
Principles of plant succession.

The first of these categories may obviously be split up into such heads as:

Clearing,
Cutting,
Grazing,
Burning,
Weed introduction,
Crop raising,
Industrial developments,
Artificial planting.

Since no complete handling of all these elements is at all possible it will be well to dispose here of a few that are either of lesser importance or are practically impenetrable, reserving the more important or more feasible for a later discussion, after the plant ecology had undergone consideration.

The height of water in the Rock River and its volume of flow is influenced not only by natural causes but by industrial development. The water is artificially ponded often behind the dam at Rockford in Winnebago County to the north

of Ogle, causing abnormally low water. This is followed by the sudden release of the water, and, consequently, unusual influences of stream flow are at work at times upon the shore lines of islands and mainland. Island formation has been greatly influenced in places by the building of bridges, as at Oregon, and the breaking of dams, as at Oregon and at Grand Detour. Artificial islands have been created by the gravel and detritus washed from a broken dam against the piers of a bridge, as about the iron bridge at Oregon. The effect of ice, when ice gorges break farther north in the river in February or March and send down the river great quantities of ice, has been marked on shore lines and on island erosion and movement. There has beeen great change in the river islands in the county within the last few decades. The map issued about 1900 by the County Superintendent of Schools exhibits a number of differences from the recent, still unpublished, map of the State Soil Survey, and it is possible today to trace the course of some of these changes. The earlier map shows a rather large island immediately north of Margaret Fuller's island above Oregon. No island exists there now, but a very small one farther up stream near the west shore shows evidence of being the remains of the former larger one, since southward from it the remains of stems of dead willows may be seen sticking above the surface at low water. In a number of other locations similar effects may be seen. The arrangement of the islands south of the iron bridge at Oregon is strikingly different now from that of the earlier map, and the reasons for this are known in the events of the past fifty years or so. The dynamism of the islands is probably still of a high rate at times so far as their disappearance and appearance is concerned, while that of their progression downstream is generally that usually encountered in a stream of this character. The canalization near the mouth of Pine Creek near the southern boundary of the county, whereby the lower end of the creek was afforded a shorter course, also presents an artificial rearrangement of natural conditions. It should be noted that much of the industrial development on the Rock assists natural causes in making the river a depositing as well as an eroding stream. The muddiness of

the water, due to the load carried, is frequently commented upon, whereas before the advent of the whites its clearness was equally noticed.

The artificial planting that has been done in the county is mainly of an ornamental nature and there is no evidence as yet of the further establishment of these introduced species by natural means. As a factor this is still negligible. Unintentional weed introduction and the natural migration and establishment of weed species of plants has, probably, been very great since the settlement period about the middle of the nineteenth century. One need refer to the case of the giant ragweed (Ambrosia trifida) alone for an indication of how widespread this influence may be upon the native vegetation. This species, locally known as "horseweed," is having a marked ill effect economically in its invasion of farm areas. The entire matter of weed introduction is a practically unknown factor, however. The effect of crop raising on the native vegetation is, like its reciprocal, the effect of native vegetation on crop areas and the raising of different farm crops, practically an unknown territory. One aspect of this that seems likely to come up before many years for careful investigation by ecological methods is the effect of grazing by domestic stock on the permanency and the yield of farm pasturage. The ecological method of regulating grazing on western ranges has already been successfully worked out and applied. The effects of grazing animals on the Rock River woodlands will be considered here, however, after the plant ecology of the areas has been dealt with. It needs merely to be mentioned now as one of the prime factors of the region in the ecology of the native vegetation. Plant diseases among the native species is a wholly unknown factor so far as the past is concerned. References occur, to be sure, in various records of county affairs, but these references are all so general in nature as to be of little value, consisting mainly of such statements as that after the severe winters of a certain period there was much disease among the native trees. It will probably remain one of the unknown factors of the past.

There remain, then, for later discussion the topics of clearing woodlands, cutting out various species of trees

from them, fires in such areas, grazing within them, with such consideration of the principles of plant succession as appear pertinent, and the matter of possible climatic fluctuation. It may be well to emphasize that what is desired even in a qualitative investigation of these factors is some knowledge of the attendant alterations in such things, for example, as soil moisture content, physical character of the substratum, effects on the plant assemblages, as well as more general information and certain outstanding principles or isolated facts.

THE PLANT ECOLOGY

Just what the Rock River woodlands contained in plants besides tree species before white settlements got under way is somewhat speculative. The most striking thing about the early accounts appears to be the great similarity between the species of trees then present in the woods along the Rock and in the woods well back from the river, that is in many of the prairie groves. Mention of "large oaks" is frequent, and sometimes a diameter of three or four feet is given for them as well as for elms. Large walnut and butternut are also spoken of and the hard or sugar maple. The writer believes that there was more mesophytism than now, that if not a very much higher degree of it, it was at least greater in areal extent.

It is believed, too, that the climax form today of the Rock River woodland region is one of very considerable mesophytism. The highest expression of this is to be seen only in spots of woodland, while certain larger areas exhibit it also but expressed in lower terms. It must be remembered that the region presents other woodland associations of high mesophytism besides this climax form. These are the bottomland association and the streamside association, almost identical in floral composition, the former of which is notable on the islands while the latter is common on the banks of the Rock and other streams of continuous flow. Here the ruling species of trees are Acer saccharinum, Ulmus americana, U. pubescens, Salix nigra, S. fluviatilis, Acer negundo, Fraxinus americana. When ungrazed, Ambrosia trifida and Urtica dioica are characteristic also. The climax form when at its highest expression contains such trees

as Acer saccharum, A. nigrum, Tilia americana, Prunus serotina, Hicoria minima, Juglans cinerea, J. nigra, Fraxinus americana, Quercus alba, Q. rubra. The following shrubs are rather typical of the undergrowth—Viburnum dentatum, V. lentago, Staphylea trifoliata, Hamamelis virginiana, and, sparingly, both Amelanchier canadensis and Carpinus carolianiana. Some characteristic herbs and ferns are Viola spp., Podophyllum peltatum, Trillium spp., Sanguinaria canadensis, Asarum canadense, Hepatica spp., Aralia nudicaulis, A. racemosa, Actea rubra, A. alba, with Menispermum canadense and Amphicarpa monoica among the lianes; Adiantum pedatum, Osmundas, Aspleniums, Aspidiums. The oaks are still the dominant trees generally both in point of numbers and of size. The maple element sometimes is represented by trees of good size but they are generally still subordinate in point of numbers. In a sense this is a beginning aspect of a climax form, as an inspection of the list of species named will indicate. The writer believes there is considerable evidence on the ground that goes to show that this form may not be the ultimate expression, under the prevailing climatic complex, but that a still more mesophytic expression may be the real climax form, if the successional development of the vegetation were allowed to take place without interference. It is speculation, of course, to indicate what the ultimate form might be. Since Fagus americana and Tsuga canadensis are absent, even as possible migrants, the beech-maple-hemlock climax of farther east is out of the question. It is conceivable, however, and rather probable, that an ultimate association might involve the well-nigh complete elimination of Quercus alba and perhaps of the more mesophytic Quercus rubra, resulting in a maple association. In much of the eastern portion of the middle west of North America a red oak-white oak-hickory association (Quercus rubra-Quercus alba-Hicoria ovata) is the climax. Sometimes the course of the succession to this is likened to that of the country farther east with the exception of the elimination of the eastern climax of beech-maple-hemlock. The association considered here as the climax of the Rock River woodlands region may be termed an oak-maple climax. It is not believed that this is, or would be if left to its natural

development, peculiar only to the Rock River region but that it would gradually spread over more or less of the county outside of that specifically dealt with in this paper. This oak-maple climax is to be seen well in portions of the Cartwright woods on the west side of the Rock north of Oregon and in the east shore part of the McCormack woods north of Byron. The association has become in large part independent of physiographic diversity, that is to say, it is found not only in small ravine heads for example, which afford especially favorable mesophytic conditions, but spread over larger physiographic areas that involve much diversity of habitat. The floral composition of the association in such examples of the climax will be treated in more detail later. From the viewpoint of geological time, of course, the mesophytism of the Rock River woodlands region is a temporary effect. Geologically later, when lateral erosion of the river has approached planation, mesophytism will have disappeared.

For contrast, in order to get an impression of the course of the plant succession, and some idea of the probable effectiveness of the factors influencing it, let us consider an association representing the other extreme, a xerophytic woodland. Although not especially concerned with the prairie groves as they remain in the county today, chiefly in the form of degenerate farm woodlots, they will, nevertheless, serve the purpose. Their mesophytism when white settlers first came into the county about 1840 has already been noticed. While not applicable to all prairie groves eighty years ago many of them certainly comprised an assemblage of plants whose mesophytism is indicated by the presence of such species as maples, walnuts and elms, besides the oaks. Today, after less than a century of occupation by the whites, these groves or woodlots generally contain an association whose retrogression is indicated by their composition of oaks and hickory. The typical species are Quercus macrocarpa, Q. ellipsoidalis, Q. velutina, Q. alba, Hicoria ovata. Since the variations comprise almost all possible combinations of these species no more definite statement is necessary. In this connection there must be compared what has happened when the course of the plant

succession was in the reverse direction. The prairie groves have exhibited a movement of plant succession towards xerophytism from a rather high form of mesophytism, as retrogression due to the activities of man. Near Lincoln, Nebraska, an area of prairie, bearing the usual sod grasses, was made, by the activities of man, to exhibit a movement of the plant succession towards mesophytism from some degree of xerophytism. Some forty years ago seedling trees were planted in the prairie sod grass. Now the sodded condition has disappeared and the area has shown progression into a rather mesophytic woodland.

Among the species given as representative of the prairie groves, or their remains, the farm woodlots of today, Quercus macrocarpa is a typical border line tree between prairie and woodland. It is also, however, a species of very different habitat, occurring in places of great soil moisture, as for example, on the Leaf River flats. It is to be found, too, in other habitats of soil moisture conditions apparently intermediate between these, where it may be a left-over from another set of conditions. It is quite possible that a statistical investigation would show it to be more plentiful in that portion of the area being dealt with that is west of the Rock River.

Having now given some attention to what may be thought of as the two extremes of woodland growth, the prairie grove or farm woodlot association of today, just outside of the Rock River woodland region and the climax form of woodland within that region, some consideration of the intermediate stages and deviations from the customary forms of these are in order. As might be expected the physiographic diversity afforded by an intrenched river valley in the way of differentiation of habitat conditions along the line of mesophytism, that is increased soil moisture and decreased evaporation, has given rise to practically all variations between the two extremes. The typical prairie grove or farm woodlot association can be found today within the Rock region as well as upon the prairie. From the oak-hickory association of xerophytic tendencies the relative frequency of the more mesophytic oaks, Quercus alba and Quercus rubra, increases as the succession goes in the meso-

phytic direction. The latter of these two species is a mark of attained mesophytism generally, while the former, though indicating an increase in mesophytism usually, nevertheless occurs in so wide a range of conditions as to be a member of many stages, or degrees of stages, of the succession. All the phases, until a low beginning form of the climax itself is reached, appear to be variations on the oak representation. The occurrence of such species as Fraxinus americana and Juglans, while representative of advanced soil moisture, are probably less representative of a definite stage of succession, though generally present in the climax.

A deviation from the regularity of the succession is shown by the association at the foot of a limestone ridge capped by sandstone on the east shore of the Rock just above Oregon, and consequently with a western exposure. The representative tree species here are Quercus alba, Q. ellipsoidalis, Hicoria ovata, Juniperus virginiana, and infrequent specimens of Quercus macrocarpa. Since the ground cover includes such herbaceous forms as Monarda stricta, Melilotus alba, Rudbeckia hirta, Desmodium illinoense, Cassia chamaecrista, the assemblage may be taken to represent a response to xerophytic conditions on a rather dry western exposure. It appears to be evident from the surrounding growth that the xerophytism hereabouts has been and is still decreasing in areal extent. It is to be noted that for a number of years past the vegetation conditions have not been interfered with materially.

A frequent response to the changed conditions afforded by a stream that contains water at least the greater portion of the time is shown by the appearance of Juglans nigra and sometimes Gleditsia triancanthos in a stand of Quercus ellipsoidalis, Q. velutina, Hicoria ovata, Quercus alba. An herb such as Podophyllum peltatum is frequent. Migrants like Acer saccharum, Hicoria minima, Celtis occidentalis, indicate the direction in which the succession is going. A good example of this is to be seen in a woodlot east of the Rock opposite Oregon. Throughout the Rock River region Hicoria minima is an excellent indicator of good soil moisture. Celtis occidentalis, on the other hand, while often occurring correspondingly, as a seeming indicator of

still greater soil moisture, is to be found as well on sites that are so much drier as to make the species unreliable as an indicator.

In Oregon township, section two, there is a stand representative of mesophytism and xerophytism condensed. Here Quercus alba, Q. macrocarpa, Hicoria ovata, Quercus rubra, Hicoris minima, Tilia americana, Ulmus pubescens, Prunus serotina, P. virginiana, and Juniperus virginiana are intermingled. It is of course, a response to the physiographic arrangement, large differences taking place in small distances.

Two of the more unusual species of oaks, out of a total of seven noted by the writer in the region of the Rock River woodlands, are Quercus acuminata and Q. platanoides. The latter is seen chiefly on some of the islands, while the former has two different forms and occurrences. It is found in a mesophytic stand, as upon the west shore of the Rock north of Oregon at the place known as the Narrows, at the foot of a wooded talus and on the inner part of the adjacent flood plain. Here Q. acuminata has the form of very thin, chestnut-shaped, acutely lobed leaves, and is a tall straight tree. It is to be found also on limestone ridges, which may be furnishing rather dry or rather moist habitats. Here the species is a short tree, or at least not tall and straight, with very much smaller leaves that are considerably thicker and inclined to be lighter in color on the under surfaces, while nevertheless preserving the acutely lobed and chestnut shaped outline. These two types are so distinct in appearance as to seem different species. In the location at the Narrows Quercus acuminata occurs with Acer saccharum, A. saccharinum, Robinia pseudacacia, Juglans cinerea, Salix fluviatilis, and Populus deltoides, as the tree species, and Alnus incana and Cornus paniculata as characteristic shrubs. Mesophytic herbs constitute the ground cover. Consequently there is a telescoping or condensation, a combination of the typical streamside association with the woodland oak-maple climax, with Quercus acuminata as the ecological equivalent here of Quercus rubra. Alnus incana is, of course, common along streams, though the genus is not especially frequent in Ogle

County. Cornus paniculata occurs in such a variety of situations as to be almost a ubiquitous woodland species.

One of the most interesting displays of oaks is to be found just west of Grand Detour on the eroded anticline of the structural deformation crossing the Rock at that place and forming the rock bluffs on the north shore of the river in its western course beyond Grand Detour. The assemblages include Quercus velutina, Q. ellipsoidalis in its type form and its three varieties of intermedia, depressa, and coronaria, Q. alba, Q. rubra, and Q. macrocarpa, the last species being nearby at least. These woods exhibit, in their part on the tops of the sandstone bluffs, but not in the portion farther back from the river, the substitution of an oak stage in the succession for a coniferous stage. The recession of conifers in this county is to be explained not alone by the fact of their becoming relics of a past climatic circle but also by the fact of man's operations of cutting and clearing. Probably if Pinus strobus had chanced to be present in the neighborhood of these sandstone bluffs in sufficient numbers to effect migration and establishment, a white pine stage would have occurred in the succession before the oaks, as is customary in this section of the country, where the series pines-black oaks-white oak-red oak, (hickory)—up to the climax, skeletonizes the succession in part. Here, however, the white pine was not present in sufficient numbers to establish itself in new territory. That it is still able to do so, when present in sufficient numbers to form a nucleus for migration, is demonstrated in the notable instance of the white pine woods on the limestone bluff of Pine Creek in Pine Creek township.

At the sandstone bluffs west of Grand Detour a dry, sandy bank rises from shortly beyond the river side and continues as a sandy site on top of the bluffs. Wherever the vegetation has been able to advance considerably the sandiness has become modified by the accumulation of humus. The streamside species, Salix fluviatilis, S. nigra, and Acer negundo, are frequent along the river. The lower bank contains such species also. The moisture conditions below the surface are there hydro-mesophytic. Fraxinus

and Ulmus are added on this lower bank. Somewhat farther up the bank Ostrya virginiana, Juniperus virginiana, Celtic occidentalis, Gleditsia triacanthos, are present. Still farther up are the oak woods. Of course these species are not in zonation, as their mentioning might indicate. More or less intermingling takes place until the area of the oaks is reached. Here, on and about the sandy top of the bluffs, are also such species as Melilotus alba, Verbena stricta, Lespedeza capitata, Strophostyles helvola, Liatris scariosa, Verbena angustifolia, Achillea millefolium, Chenopodium album, Physalis sp. These herbaceous forms are practically all those of dry sandy sites, the so-called waste places. Affinities with the prairie vegetation are to be seen in such as Verbena stricta and Liatris scariosa. More than half the species mentioned belong to the weed class. Melilotus is of general occurrence throughout North America, except in the far north, on sites of this character. The upper layer of this sandy soil on the top of these bluffs appears, hence, to be rather dry, while the deeper soil layers contain much more moisture, at least as judged by the vegetation supported. Upon one of the sandstone cliffs occurring along these bluffs, the small cliffs known locally as "buttes," Pinus strobus occurs sparingly at the verge. Juniperus virginiana, Quercus alba, Q. ellipsoidallis, Q. velutina, small Populus grandidentata, with Carpinus caroliniana and Pyrus melanocarpa were also present on the cliff top. In the oak woods farther back from the river, where the stand of trees is much denser and the soil conditions much better, where in short a later stage of succession has been attained, such an assemblage as the following is representative: Quercus alba, Q. rubra, Q. velutina, Q. ellipsoidalis, Tilia americana, Juniperus virginiana, Hicoria minima, H. ovata, Fraxinus americana, Ulmus pubescens, Prunus serotina. In the undergrowth occur Ostrya virginiana, Cornus paniculata, Xanthoxylon americanum, and so on. The succession has passed in large part from the oak woods stage of the top of the bluffs but still retains many traces of the former. Considerable habitat differences within small areas are here a feature of this.

An extraordinary deviation from the ordinary course of succession in the county today is exhibited by an area outside of that of the Rock River woodlands but worthy of note here because of its developmental relation. In the southwest part of Ogle County on the flat top of a Galena limestone cliff on Pine Creek there are about twenty acres of dense growth of Pinus strobus some seventy to ninety years old. The entire potential area may be said to be approximately a hundred acres or so.

Early settlers state that about 1840 the white pine growth extended irregularly along Pine Creek for a number of miles and reached out in places on either side of the creek, with a number of groups of dense stands like the one remaining. The species is undoubtedly a relic that exists now in the county only in a few small patches or as occasional individuals in inaccessible localities, those unfitted for farming and for grazing, and possibly also such as have been in the past fairly secure from damage by prairie fires.

This Pine Creek stand, whatever its manner of origin, is today and has been for some years past a remarkably strong seedling center. Adjoining it on the east is the customary oak upland woodland of the county. The prevailing winds are from the west and these scatter enormous quantities of pine seed from these vigorous trees to the eastward on favorable seeding ground. But here occurs the stand of upland oaks. It must be observed, however, that these are two extremely different habitats lying alongside each other. The one, on which the pine is growing, is a shallow, residual limestone soil with rock outcrop. The other, on which the upland oaks are growing, is a deep, upland timber soil of yellow-gray silt loam. The former is of much lower soil moisture content.

When the pine stand was of somewhat smaller extent it is probable that some oaks grew on what is now pine area. Perhaps certain small portions, or crevices in the latter, furnished greater soil moisture than the limestone pine area in general, thus permitting the oaks to grow there before they had to meet competition from the pines. The

dissemination of the pine seed has been for some time past and is now so vigorous, however, that it appears to the writer to account, in connection with the other matters recounted here, for the reversal found of the usual course of succession. Here, instead of the pine woods being invaded by the oaks, as usually takes place in the eastern United States, the oak woods are unquestionably being invaded by the white pine along the oak woods-white pine border zone in the territory of the dense white pine stand.

Let us consider now a few localities of the region that are representative of the climax and of certain plant assemblages that are on the other hand removed somewhat from the regular course of succession. In the big bend of the Rock at Grand Detour some herbaceous forms are of interest. This flat, consisting mainly of the terrace soil yellow-gray sandy loam over gravel, with some parts of the bottomland soil mixed loam, and a small area of sandstone rock outcrop, formerly bore a mesophytic woodland with oaks, walnuts, and so on, of large size. The whole area is now under cultivation, except for the part comprising an abandoned channel of an artificial mill stream, and only a border zone of streamside vegetation is present along a portion of the Rock. Some of the herbs in the streamside border and in the cultivated fields are Ambrosia trifida, which is very prominent, A. artemisiifolia, A. ludoviciana, Oenothera biennis, Convolulus sepium, Acnida tuberculata, Silphium perfoliatum, Polygonum pennsylvanicum, Vernonia fasciculata, Brassica sinapistrum, Bidens sp., with many other forms. A large number of the grasses of the county are to be found here as well. Here, in a cultivated area, as in the so-called waste area of the sandy bluff tops west of Grand Detour, prairie forms (such as Silphium perfoliatum and Vernonia fasciculata) and weed forms have found a habitat suitable for their establishment.

The McCormack woods on the east shore of the Rock north of Byron are of great interest. They comprise nearly one square mile, and several parts of the area illustrate the climax form of the Rock River woodland region. One reason for this is unquestionably the fact that these woods have been practically ungrazed for some time. A dozen or

a score of deer have been introduced, but their effects are negligible. The area, too, is one having sufficient topographic diversity to be representative. In the climax expression Quercus alba is still probably the dominant species. The other representative species are Acer saccharum, A. nigrum, Hicoria minima, Prunus serotina, Juglans spp., Tilia americana, Fraxinus spp., Ulmus spp., Quercus platanoides, Populus tremuloides, Quercus ellipsoidalis, Hicoria ovata, Quercus velutina, Populus grandidentata, and some gnarly specimens of Quercus macrocarpa of irregular growth. Ostrya virginiana is very abundant. The undergrowth is notable chiefly from the great variety of shrubs rather than from particularly characteristic species. Most of the shrub species of the region are present. The ground cover consists of mesophytic herbs, such as Asarum canadense, Viola spp., Hepatica spp., Sanguinarea canadensis, and many others. Mesophytic ferns are in great abundance. About the edges and in openings of these woods there are invaders of a xerophytic or xero-mesophytic sort, such species, for example, as Euphorbia corollata, Helianthus hirsutis, Verbena angustifolia, Eupatorium urticaefolium, Campanula americana.

The Heckman woods on the east shore of the Rock just north of Oregon also exhibit in spots the climax form of the region. Here again Quercus alba is the dominant tree species. Quercus rubra is here, however, almost as important. Other tree species are Hicoria ovata, small Fraxinus americana scarcely over five feet in height, Prunus serotina, Quercus ellipsoidalis, Q. velutina, Juglans spp. Acer saccharum, although present, is not yet of any importance in the tree community. The frequent occurrence of species like Hicoria ovata, Quercus ellipsoidalis and Q. velutina, when taken in conjunction with the more mesophytic undergrowth and the quite mesophytic ground cover, indicate clearly that the succession, while advancing towards a mesophytic climax, has not yet reached a full expression of this, since Acer saccharum is negligible and even absent yet in parts. In the more mesophytic undergrowth are such shrubs as Hamamelis virginiana, Xanthoxylon americanum, besides the less representative species of the

region, such as Cornus, Ribes, Ampelopsis, Toxylon, Rubus, Rhus, Vitis, Pyrus. Some small trees, but a few feet in height, of Fraxinus quadrangulata are present. The ground cover is much the most advanced layer, affording the best indication of the approaching mesophytism of the other strata of the vegetation. Here are such herbs as Thalictrum dioicum, Polygonatum spp., Trillium spp., Podophyllum peltatum, Arisaema triphyllum, Caulophyllum thalictroides, and so on. There is a fair assemblage of mesophytic ferns, Aspleniums, Aspidiums, but not so great a display as in the McCormack woods. In this connection it must be noted that here the topography often, even where the mesophytism has advanced to the point just described, furnishes no especially favorable conditions for mesophytism. There are, to be sure, spots where topographic conditions give mesophytic sites, but this area of the Heckman woods has advanced well as a whole towards the climax, and evidently from much less mesophytic oak woods phases of the succession. It has, apparently, been left for some years without noticeable disturbance by grazing or other factors that make for retrogression. The younger tree growth is represented by such species as Fraxinus americana, Prunus serotina, Ulmus spp., Juglans spp., and Hicoria minima, clearly indicating an advance beyond the older tree stand of Quercus alba, Q. ellipsoidalis, Q. velutina, Hicoria ovata. There is evidently greater soil moisture throughout this whole woods than in the ordinary upland woods of the region, and this greater quantity appears to result from the presence of the dense stand of the woodland rather than from any especially favorable topographic arrangement. In some parts of the area Tilia americana, Acer saccharum, Quercus acuminata, Q. alba, Juglans nigra, J. cinerea, Quercus rubra, Hicoria minima, Robinia pseudacacia, occur. The Acer saccharum, though small, still proves clearly what the future of the succession will be if the vegetation continues to be left undisturbed.

The Cartwright woods on the west shore of the Rock north of Oregon, while in places a much confused assemblage of telescoped and condensed stages, nevertheless exhibits the oak-maple climax form excellently over some of

its area. These woods also show well a marked feature of most of the Rock River woodlands, that is, the decided increase in mesophytism in proceeding from portions back from the river towards portions near the river. This is what might in general be expected on an intrenched valley slope. The physiographic diversity, however, occasions many places where this might not be the case. Nevertheless when the vegetative succession is allowed to proceed without disturbance it appears to be quite general. In the Cartwright woods at their western part, that is the portion farthest from the Rock, Quercus macrocarpa is prominent in the stand. Towards the eastern part this species is almost lacking. The increase in mesophytism from west to east is shown by the appearance and increase in numbers of such trees as Juglans nigra, J. cinerea, Ulmus americana. On higher and drier parts of the area, mainly at the western portion, Quercus ellipsoidalis is the chief tree. The more mesophytic eastern part bears the more mesophytic herbs, although in some small areas westward, where especially favorable conditions prevail on account of the topography, such herbs are also prominent. In one part of these woods there occur old trees of Quercus alba, usually with short bole and much branched form. They are quite the oldest trees of these woods. Their appearance suggests that they have belonged to an older stand that was largely open-grown. Into this older stand, presumably, there came the later, present stand of Quercus ellipsoidalis, Q. velutina, Q. alba, Hicoria ovata, and others, from which the still later, more mesophytic, phase of the succession has developed. The species of the climax here do not differ materially from the examples of it already described, except that in these Cartwright woods there is some Betula lutea. This species occurs in a few other places also, being usually present as an expression of certain especially favorable, very localized habitats, rather than as a regular member of the oak-maple climax form.

An extremely mesophytic assemblage representative of the moist areas at the heads of small ravines and other similarly moist areas is shown at the ravine head on the north slope of Liberty Hill back of the town of Oregon. Here

Quercus is perhaps the chief tree. Fraxinus americana and Hicoria minima are prominent. The undergrowth is not remarkable, being about that found in the climax form of the vegetation. Carpinus caroliniana is somewhat prominent, however. Typical mesophytic and hydromesophytic herbs abound, and this, with the fern display, consisting of Osmundas, Aspleniums, Aspidiums, Cystopteris, Adiantum, Polypodium, with a profusion of mosses and lichens on and about the moist sandstone rock wall forming the actual head of the ravine, are especially characteristic.

The island vegetation is another very mesophytic form, but of another sort. Omitting the streamside association the islands generally bear a vegetation about as follows. Ulmus americana and U. Pubescens may be considered the chief trees. Fraxinus nigra, F. americana, Juglans nigra, Celtis occidentalis, Juglans cinerea, Prunus serotina, Acer saccharum, A. nigrum, make up the other prominent species. To these may be added such others of occasional occurrence as Tilia americana, Ailanthus glandulosa, Quercus platanoides. Of course species like Acer saccharinum, Acer negundo, Salix nigra, of the streamside association, are often present as well, back from the borders of the island.

Consequently, from a comparison of the tree species alone, it may be concluded that there is here, in places at least, a telescoping of the climax form with the streamside association, and, on most islands, certain special bottomland or island features, such as the occurrences of Quercus platanoides, or a superabundance of Ulmus. The undergrowth is very similar to that of the oak-maple climax, with, however, much more of liane growth. Often plants of hydromesophytic are combined with plants of xero-mesophytic tendencies, as when, for example, Cephalanthus occidentalis and Crataegus occur near together. Shrubs such as Cornus sericea, Sambucus canadensis, Staphylea trifoliata, are frequent. The ground cover combines herbaceous form of hydrophytic and mesophytic tendencies.

In the Rock River woodland region, as well as one may judge by observation alone, it appears that the main influence on the progression of the plant succession is the soil moisture content. Of course this is the most obvious ele-

ment of the complex, and undue emphasis may therefore easily be given it. Nevertheless, in spite of the obscurity of such factors as temperature and evaporation by observational methods, there seems to be sufficient evidence to regard soil moisture as the prime factor. As the soil moisture content increases the succession here progresses towards the oak-maple climax, and as it decreases the succession retrogresses towards xerophytism, towards something very like what the old prairie groves of the county now are or towards a somewhat less xerophytic form of such woodland. This is without reference in this place to the particular immediate causes.

There has not appeared to the writer to be any marked difference in the vegetation upon soil derived from limestone or sandstone, or, indeed, a difference in the vegetation upon any of the soils of the region that is dependent upon the character of the soil material itself, ergo as sand or lime. Of course on a residual sand, for example, the physical characteristics of such a soil yield in the early stages of plant succession a very different habitat than a clay soil. But these differences are not due to any chemical feature apparently. They are, in later stages of the succession, wiped out completely. It is true that several of the plant species known commonly as those of limestone do occur most frequently on such sites. Pellaea atropurpurea is a notable example. But this fern occurs also on sandstone, even if less frequently. This species with Pellaea gracilis rarely, and with Cystopteris fragilis, C. bulbifera, Woodsia ilvensis, and of course Polypodium vulgare, are the frequenters of rock wall crevices and cliffs. Much of the diversity that appears between sandstone and limestone cliffs seems to be explainable along the Rock and its tributaries by certain other factors. For one thing the sandstone cliffs are mainly along the Rock River, where man's activities have been greatest, and these cliffs present a more xerophytic habitat largely because of such activities. Castle Rock, for instance, on the east shore of the river between Oregon and Grand Detour, composed of nearly white, non-fermuginous sandstone, a very pure silica, is to a great extent without vegetation owing to trampling by visitors.

Other sandstone cliffs, of more remote location, present habitats of advanced mesophytism. This consideration is independent, of course, of high moisture content obtained in some cases, and by a cliff of any sort of material, by peculiarly advantageous seepage conditions related to stratification. Such advantageous moisture conditions frequently are found at the foot of cliffs, and occasionally on their slopes.

While the topographic location of the soil is important in relation to its moisture content, the growth and development of the vegetation itself is of immense importance in determining what the moisture content will be. Before this influence becomes operative in any marked degree the other factors are controlling; the topography, the physical character of the soil, what man has done or is doing to affect the nature of the area. Outside of the Rock River woodland region, out in the prairie groves, a different case obtains. In these isolated woodlots on upland prairie a number of other factors besides that of soil moisture become prominent to differentiate them from the area which is chiefly under consideration in this paper. Factors of a general climatic nature put them in another class. In the woodland region of the Rock it appears to the writer likely that the influences of other factors are largely wiped out and that the influence of soil moisture content dominates.

Any careful examination of the plant life of the Rock River woodland region will bring into notice a phenomenom that appears to be a swinging of the successional trend, now in the xerophytic direction, now in the mesophytic direction, but irregularly. All that is known of the laws of plant succession goes to indicate that, under any particular climatic complex, plant succession will advance to its climax form through various successional stages, unless thrown into retrogression by some external influence. Since the local accounts repeatedly mention marked weather changes in the past, since the advent of white men to the county, and since the whole area is located in a traditional region, one is, at first, strongly inclined to attribute the phenomenon to minor climatic fluctuations, those changes in the weather conditions that present marked minor departures from the

normal over periods of some few decades. Since white men have been in this region only for some eighty years past, no climatic change other than a very minor fluctuation would be traceable, could we obtain weather records for this entire period. Such a record is, of course, not to be hoped for. This swing, which is a thing of the mainland entirely and not of the islands, is seen most clearly in the more advanced phases of succession, say in the white oak-red oak-hickory stage, or some approximately equivalent phase of the successional series, or in a later, more mesophytic, phase. Hereabouts it will become apparent that of two seemingly similar assemblages one is advancing in the mesophytic direction while the other is retreating in the xerophytic. Thus the two assemblages of similar aspect are exhibiting respectively progression and retrogression. This sort of thing may be seen in portions of the Cartwright woods and in areas that are near if not actually in the Heckman woods near Oregon, on the west and the east shores respectively. It seems rather sure that the same occurrence takes place with earlier stages of the succession, but in these it is obscured and would probably require statistical methods to make it clearly evident.

Let us look into the matter of possible minor climatic fluctuations. Accounts are conflicting, but from them all it seems to be believed that about 1880-1900 there were unusually severe winters followed by unusually hot, dry summers, and that, accompanying and following this, great insect damage was done to the foliage of the native vegetation, the tree growth being mentioned particularly. A number of single seasons are spoken of as unusually cold or dry, and so on. Unfortunately information as to plant diseases of the native vegetation in the past is and will probably remain unobtainable. It can only be hoped that at some future time records will be made and preserved of such data both for its intrinsic interest and value and for its application in problems of economic importance. It is now in all consideration of the vegetation an unknown factor.

Another unknown factor, but in this application one that is little mentioned, is that of fires in the woodlands of the

region since the settlement by white men about 1840. Fires, for example, starting at the railroad on the north of the Pine woods in Pine Creek Township, run not infrequently southwards through the area where white pine reproduction generally occurs in the oak woodland adjacent, and are a factor in the successional changes, but here again an uninvestigated factor. There is no evidence, however, in the Rock River woodland region of any such periodical recurrence of fires as would be effective directly or indirectly in bringing about a swing in the successional stages such as has been referred to. The supposed damage to woodland growth by unfavorable climatic changes and plant disease is said to have eventuated economically as follows. The first settlers located themselves in the prairie groves and in the woodland along streams, having a prejudice against the sod of the prairie for farming and also because of the water and the protection from wind afforded by the woods. These early settlers, however, were few in number and did not greatly alter the original extent of the wooded area of the county. Later settlers took up the prairie soil chiefly. Thus the wooded area of the county was preserved without much change in extent until a still later date. Then, according to the local accounts, in about the period of 1880-1900, the damage to tree growth by unfavorable seasons and disease caused much clearing to be made in the wooded areas.

It has been established by meteorologists that no permanent change is taking place in the climate of the country within historic time. Within geologic time periods a change may eventuate. Records available in this country are too short to afford any definite indication of any but short period fluctuations. The longest cover a period of only about 100 years and very few stations have records of more than 50 years in length.

Unfortunately there is no more than some fragmentary records of meteorological conditions in Ogle County. Not far from this county, however, in the same general locality, there does exist one of the oldest and longest series of records for both precipitation and temperature in the entire state. These are for Marengo (formerly Riley) near the

Kishwaukee river in southwestern McHenry County. This is sufficiently close to the Rock River region of Ogle County and sufficiently like it to furnish results for the different seasons (seasonal averages) that are quite comparable. Indeed, it is probable that this McHenry County record furnishes very good information of what the four different seasons of the years involved were throughout the northern part of the whole state. The Marengo records run from 1850 to 1917 for precipitation, with but very few breaks in only three years out of these sixty-eight. The temperature records run from 1856 to 1917, with but very few breaks in only two years out of these sixty-two. For the purposes of this paper seasonal figures have been calculated. The U. S. Weather Bureau practice of calling December of the previous year with January and February of the current year the winter season of the current year has been followed. Then the spring season consists of March, April and May of the current year, with the summer and autumn seasons June, July, August, and September, October, November of the current year. For temperature the means of the four seasons (average monthly temperatures), and the annual means, are given. For precipitation the means of the four seasons (average monthly precipitation), and the annual totals are given. The former is expressed in degrees Fahrenheit and the latter in inches of rainfall. For making these seasonal calculations the records of monthly mean temperatures and annual temperatures, and the monthly precipitation and annual precipitation figures were used.* These monthly figures are not given in this paper, however, since it is believed that, for furnishing data representative of conditions in Ogle County, the seasonal monthly averages are better. The three pages following give this data for the different years in tabular form. As a sort of norm for the comparison the following average monthly precipitation figures for the different seasons have been calculated from published data,** for the northern central portion of Illinois.

---

*Monthly Wea. Rev. Washington, Feb. 1888, p. 53.
Ill. Climate & Crops Rep. s. 1901-1910.
U. S. Wea. Bur. Climatological Data, 1910-1917.
U. S. Wea. Bur. Springfield, Ill., Records 1888-1900.

**Kincer, J. B.: Seasonable distribution of precipitation and its frequency and intensity in the U. S. Month. Wea. Rev. 47:624-31, 1919.

Average monthly precipitation in winter 1.3—2.0 inches
do in spring 2.7—3.3
do in summer 3.3—4.0
do in autumn 2.7

PRECIPITATION

(Inches)

YEAR	Seasonal Monthly Means: Winter Dec. prec. yr. Jan. Feb. curr. yr.	Spring Mar. Apr. May	Summer June, July Aug.	Autumn Sept. Oct. Nov.	Annual Totals
1850	——	2.8	10.1	3.1	53.1
1851	2.5	6.5	7.0	2.8	56.9
1852	2.3	6.0	2.2	3.4	42.0
1853	2.5	4.0	4.9	4.5	45.4
1854	1.3	——	——	——	——
1855	——	——	9.1	2.2	——
1856	2.2	2.8	2.5	2.6	31.4
1857	3.2	3.7	4.5	2.3	38.0
1858	0.8	4.7	7.1	4.5	50.3
1859	1.6	3.9	1.7	3.0	29.8
1860	1.0	2.6	3.2	2.8	29.9
1861	1.6	3.8	3.5	3.4	36.6
1862	3.3	2.3	2.5	2.4	41.1
1863	1.8	2.4	1.8	2.2	25.6
1864	1.1	1.9	2.9	2.0	23.9
1865	3.1	2.1	5.8	2.1	37.2
1866	0.7	2.3	5.7	3.6	39.9
1867	2.2	2.6	4.3	1.2	27.9
1868	1.1	5.2	5.0	3.6	44.8
1869	1.9	3.0	6.7	2.0	42.5
1870	1.9	2.2	3.1	3.1	29.5
1871	1.9	2.2	3.1	2.3	27.8
1872	0.9	3.2	3.6	3.7	33.3
1873	1.1	3.1	2.4	2.0	28.4
1874	2.4	2.0	2.3	2.1	24.4
1875	1.3	2.2	3.9	3.6	34.7
1876	4.5	6.3	5.7	6.7	72.8
1877	2.5	3.1	3.5	3.2	34.5
1878	1.9	3.3	3.6	2.4	32.4
1879	1.6	2.6	4.2	2.6	32.6
1880	2.4	2.4	4.1	2.5	33.3
1881	2.5	3.5	4.2	4.6	47.2
1882	2.1	3.8	3.4	2.7	35.4
1883	2.9	3.0	2.7	3.5	35.9
1884	1.6	2.3	3.9	3.3	35.0
1885	2.5	2.0	4.9	2.8	35.8
1886	2.5	3.5	2.9	1.9	31.2
1887	3.2	1.2	2.9	3.1	33.2
1888	1.9	3.0	2.6	1.6	26.4
1889	1.6	2.7	2.5	1.5	24.5
1890	1.9	3.1	4.7	2.6	36.4
1891	1.7	3.4	3.1	1.9	31.3
1892	1.7	5.1	6.5	0.9	43.2
1893	1.6	2.8	2.6	3.0	30.0
1894	1.7	3.1	1.0	6.5	35.5
1895	1.0	2.0	3.0	1.8	25.9

PRECIPITATION—Continued

(Inches)

YEAR	Seasonal Monthly Means: Winter Dec. prec. yr. Jan. Feb. curr. yr.	Spring Mar. Apr. May	Summer June, July Aug.	Autumn Sept. Oct. Nov.	Annual Totals
1896	1.7	3.3	2.8	3.9	32.5
1897	2.1	2.5	2.3	1.4	25.2
1898	2.8	3.1	4.8	2.4	38.7
1899	0.8	2.3	3.1	1.6	24.2
1900	2.1	1.9	5.2	2.4	33.7
1901	1.2	1.6	2.3	1.3	19.7
1902	1.0	3.3	5.2	3.1	39.1
1903	1.5	3.4	4.3	3.1	35.9
1904	1.6	3.0	2.7	2.1	28.0
1905	1.3	4.5	5.8	3.0	40.7
1906	2.0	2.0	2.7	2.8	28.6
1907	1.8	3.0	4.4	2.2	34.2
1908	1.5	5.0	2.9	1.0	31.8
1909	2.0	3.5	3.4	2.7	38.8
1910	2.6	2.7	1.9	1.8	22.5
1911	1.3	2.4	3.9	3.8	34.9
1912	1.0	2.1	5.3	3.6	35.3
1913	1.3	3.4	4.1	2.7	33.7
1914	1.0	3.5	3.1	2.4	31.6
1915	1.7	2.4	3.7	2.8	30.5
1916	1.8	2.9	3.8	3.8	38.7
1917	1.4	2.6	2.6	——	——

TEMPERATURE

(Fahr.)

YEAR	Seasonal Monthly Means: Winter Dec. prec. yr. Jan. Feb. curr. yr.	Spring Mar. Apr. May	Summer June, July Aug.	Autumn Sept. Oct. Nov.	Annual Means
1856	——	46.2	72.7	49.7	46.1
1857	17.7	39.7	71.5	48.0	45.6
1858	28.0	63.3	73.0	49.7	48.9
1859	25.7	45.8	68.8	59.1	46.4
1860	20.6	46.4	67.2	46.3	45.7
1861	23.0	44.0	66.4	47.4	46.0
1862	22.8	43.1	68.0	48.8	45.6
1863	28.0	46.8	68.1	49.8	47.1
1864	23.9	45.7	71.2	47.1	46.1
1865	21.0	48.3	67.3	53.1	47.3
1866	19.7	44.1	69.1	48.4	45.6
1867	21.0	40.3	75.1	51.2	46.2
1868	18.9	46.1	71.4	45.4	45.1
1869	20.7	42.6	67.5	43.0	44.7
1870	22.8	47.6	70.9	50.9	47.9
1871	22.8	48.2	68.6	46.0	45.9
1872	18.7	42.2	70.1	44.9	43.6
1873	14.1	41.9	70.4	43.3	43.6
1874	23.1	41.6	70.9	48.1	45.7
1875	11.2	40.9	66.0	43.2	40.9
1876	27.0	43.5	69.6	45.0	44.6

TEMPERATURE—Continued

(Fahr.)

YEAR	Seasonal Means: Winter Dec. prec. yr. Jan. Feb. curr. yr.	Monthly Means: Spring Mar. Apr. May	Summer June, July Aug.	Autumn Sept. Oct. Nov.	Annual Means
1877	17.9	——	68.1	48.7	——
1878	31.1	48.7	69.4	48.2	47.5
1879	15.7	45.9	69.4	49.2	45.5
1880	26.9	46.8	69.7	42.7	46.2
1881	14.3	43.4	69.9	49.9	45.6
1882	27.8	42.8	66.6	50.1	45.7
1883	14.3	41.3	63.4	46.1	42.4
1884	17.9	43.3	66.4	49.8	44.0
1885	16.4	40.5	66.9	46.8	41.8
1886	18.5	45.2	68.7	47.9	44.4
1887	16.0	46.2	70.7	45.0	45.1
1888	15.9	40.5	67.8	46.3	43.1
1889	22.5	46.1	64.3	46.3	46.2
1890	30.1	41.7	68.7	48.4	46.3
1891	25.5	43.7	66.5	49.3	46.7
1892	24.6	42.2	68.5	48.1	44.8
1893	13.6	39.4	69.9	48.7	43.2
1894	20.9	48.4	72.2	48.4	48.2
1895	18.2	46.1	70.9	47.5	45.4
1896	24.4	49.2	69.9	46.8	47.6
1897	24.1	44.2	69.4	53.2	47.1
1898	22.5	47.4	71.2	47.5	47.7
1899	18.5	46.2	72.3	53.5	48.0
1900	22.1	45.7	71.6	53.2	48.4
1901	20.8	45.9	73.9	50.3	47.2
1902	20.4	48.3	67.4	52.4	47.5
1903	21.9	49.6	67.1	49.4	46.5
1904	14.6	44.4	68.1	51.7	45.2
1905	16.8	47.3	69.4	51.2	46.6
1906	26.3	45.3	70.6	55.3	48.6
1907	24.5	43.8	68.8	48.9	46.5
1908	24.5	47.6	69.4	53.3	48.6
1909	26.5	43.8	70.1	51.1	47.0
1910	18.1	50.0	71.7	49.7	47.8
1911	24.0	48.2	71.7	48.7	48.8
1912	17.4	44.2	68.1	51.9	45.3
1913	24.7	45.6	71.2	52.1	48.7
1914	25.6	47.4	71.0	53.5	48.1
1915	21.8	46.6	65.2	52.3	47.0
1916	22.9	45.0	71.2	50.0	47.0
1917	27.0	43.6	67.6	——	——

The precipitation figures given in the table will show the amount of departure from the general average conditions for the northern central portion of Illinois. For temperature the table figures themselves furnish ample comparison for normal and abnormal conditions.

Examining the annual figures for precipitation only nine or ten years out of the whole sixty-eight show marked variation from the normal. The years 1863, 1864, 1874, 1889, 1895 (possibly), 1897, 1899, 1901 (with a total annual precipitation of only 19.7 inches, which is phenomenally low in a region where normally there is around 30 to 35 inches) and 1910 are the ones with low annual precipitation.

The statement has been made that "since 1885 the rainfall has decreased" in the Rock River watershed as a whole.* To test this for the northern part of Illinois the figures for annual precipitation have been added for five year periods both before and after 1885, the data furnishing six of each, and the average annual precipitation for each of such periods calculated. These data are as follows:

Period	Average Annual Precipitation	Totals
1856—1860	35.9 inches	
1861—1865	32.9	
1866—1870	36.9	
1871—1875	29.7	214.4 inches
1876—1880	41.1	
1881—1885	37.9	
1886—1890	30.3	
1891—1895	33.3	
1896—1900	30.9	
1901—1905	32.7	191.5 inches
1906—1910	31.2	
1911—1915	33.2	
		22.9 inches

This would indicate that there had, indeed, been a slight decrease in the total annual precipitation since about 1885. But an examination of the figures for the separate years shows that the year 1876, which falls, of course, within the first period — that before 1885 — had a most phenomenally high annual precipitation, a total for the year of 72.8 inches. If the difference between this and an

*Schwarz, G. F.: The diminished flow of the Rock River in Wisconsin and Illinois. U. S. Dept. Agric. Bur. of For. Bul. 44, 1903, Page 8.

assumed general average of 35 inches for the year, which would be a high general average, be taken, the figure of 37.8 inches is obtained. If this excess of over 35 inches for the phenomenal year 1876 be deducted from the total for the period before 1885 this whole period becomes of the same magnitude as that of the period after 1885. Further, the year 1901, of the latter period, was phenomenally dry, having a total annual precipitation of only 19.7 inches. Consequently it does not appear, on the whole, safe to say that there has really been any change in the rainfall of this region of northern Illinois in more than a half century.

An inspection of the seasonal monthly means of precipitation shows considerable deviation from the normal in a number of single years for each of the four seasons, but there does not appear any change running over a series of years for any of the seasons, within the total period for which data exist. The winters of 1858, 1866, 1872 and 1899 show low precipitation, while those for 1876 (which was a year of very phenomenally high precipitation throughout all the four seasons), and 1887 show high precipitation. With the exception of the phenomenally low precipitation of the year 1901 the growing seasons (spring and summer) of the different years show rather a number of individual years with amounts above the usual than years with amounts below. The period 1850-1853 appears to have had unusually high precipitation for the growing seasons. The remaining years with unusually high precipitation are scattered, 1858, 1865, 1866, 1868, 1876, 1892 and 1905.

Examining the annual figures for temperature, the annual means, a remarkably harmonious series is discovered. For the whole period of sixty-two years the greatest difference, that between the maximum and the minimum annual mean, is only 8 degrees. The winters of 1879, 1881, 1883-1888 inclusive were unusually cold, but the remaining seasons of these years presented nothing abnormal in the way of average monthly seasonal temperatures. Unusually low precipitation followed for the summers of the years 1883, 1886, 1887 and 1888, while the spring of the year 1887 also had unusually low precipitation. It is about this period that the damage to native vegetation, so often referred to

in the county, was said to have occurred, along with the extremely dry year 1901, when the temperature, however, throughout all four seasons presented nothing abnormal. The seasonal monthly means for the remaining seasons present remarkably uniform figures.

It is, therefore, evident that there is nothing in the way of climatic fluctuation of a periodic nature within the last fifty or sixty years at least within the region of the Rock River woodland and thereabouts to account for any swinging of the successional trend between the xerophytic and the mesophytic directions. The only marked feature would be that of the rather unfavorable years of about 1879-1888, when even then, not all of these were sufficiently unfavorable to afford sufficient reason for much effect upon the native vegetation. The effect, especially if aided by plant disease of insect attack history, would be retrogressive. Recovery from such a setback would mean a return to the former rate of progression, or something approximating it. A lag in the response of the plant associations would probably alter the dates somewhat for vegetative changes.

The writer believes, however, that it is not any climatic change, and probably not materially any plant disease attack, that is mainly responsible for the seeming swinging of the succession, nor for the marked alterations in the nature of the native plant growth of the county. A general observation only of the Rock River woodland region would, it is believed, lead one at first to the conclusion that, instead of any swinging of the successional trend, there is a pronounced movement in the xerophytic direction. Closer observation and the consideration given to the climatic data available bring the writer to the conclusion that the affair is related mainly to man's interference with the native vegetation. Where the activities of man have caused interference, there retrogression of the vegetative succession has occurred and occurs today. Where man has not interfered in the past with the native vegetation, there it has advanced in the mesophytic direction, that is to say progression of the vegetative succession has occurred. And whenever man has, after such interference, ceased his re-

trogression-causing activities, there progression of the vegetative succession has been resumed. The potentiality of the region for advanced stages of the vegetative succession has remained unchanged, except in so far as the activities of man may have permanently altered this. Those dealing with genetic plant geography would probably all agree that the glacial ice advance was a catastrophic event in the history of vegetation. To a lesser degree, but to how much less is uncertain, the advent of white men and their brief stay of less than a hundred years in this region has been absolutely catastrophic in its effect upon the native vegetation. Not the speed of the reaction chiefly but the degree of the effects is important. And it has been practically wholly retrogressive. It must be remembered that here the discussion is concerned wholly with matters of plant life separate from all economic questions. The economic desirability of the proper handling of woodland growth, of grazing, and so on, is, of course, absolutely unquestionable.

There are many evidences in the Rock River woodland region of the disastrous effects on the native vegetation of the clearing of wooded areas. On the west side of the Rock, in the upland timber soils especially, gullying is so common in farm fields that frequently makeshift measures to stop or reduce the damage are encountered. It is of common occurrence on both the west and the east sides of the river to find during the summer many small streams with dry beds, streams giving evidence in the nature of their cutting and in the dead or passing vegetation of their banks of having once been fairly permanently watered. Then, too, in a few places, where such small streams are still protected in their flow by wooded areas, they are found with running water throughout the summer. It seems certain that, allowing for all natural exaggeration in the early accounts, in the early days of white settlement and for unknown years before that time the prairie fires were a factor of prime importance in the development of the native vegetation of the region. The early records of Ogle County are one with the records of similar sections of the country in

recounting the ravages of such fires. They cannot be accounted as having been less than catastrophic in their nature.

Today, however, the factor of man's activities that appears to be that most actively operative is the grazing of domestic stock in woodland areas. About the entire gamut of grazing is being run—cattle, horses, pigs, sheep, goats, and deer. It is extremely rare to find any place where grazing is practiced where the number of grazed animals has been held down to such a number as would cause little or no deterioration of the fodder plants, not to speak of the native vegetation as a whole. The consequence is that not only has the grazing been impaired but the productiveness of the land itself has become impaired, except where it was shortly converted into farm crop land. Back from the Rock River in many or most of the farm woodlots, where, apparently, the purpose is to obtain permanent pasturage for domestic stock, the areas have been so reduced and impaired by overgrazing as no longer often to afford pasturage, having been reduced merely to shaded places for stock.

The effect of all these matters, when considered from the point of view of their action on the habitats involved, is believed by the writer to be chiefly of an edaphic nature, a matter of affecting the soil moisture content. For more complete elucidation of the numerous questions involved the line of attack would have to be a series of investigations planned for quantitative work. On the basis of data furnished by observational investigations such further questions might be determined.

Perhaps it will some day be recognized generally in this country that, as the elder Cockayne, a foreign botanist, has said—"The yield per acre in crop or meat is primarily a matter of the plant covering of the farm," that "facts based upon the study of a virgin vegetation and on that of an artificial or modified vegetation are of equal value, the same laws governing both," and that, hence, "the ecology of virgin land is, then, the ecology of the farm, except that on the latter man can purposely alter the conditions to which the plants are subject in order to increase their economic effi-

ciency." "Agriculture is neither more nor less than applied plant and animal ecology." Although the present investigation has been one wholly separate from all economic questions, being one entirely in pure plant ecology, it is evident that in the near future many similar investigations will need to be undertaken in the field of applied plant ecology.

REFERENCES

Bradfield, Wesley.
Typical Forest Regions in Illinois.
A Report Based on Preliminary Examinations.
U. S. Forest Service. MSS. 1908. Unpublished.

Eikenberry, W. L.
Some Notes on the Forests of Ogle County.
Trans. Ill. Acad. Sci., Feb. 1912.

Hall, R. C. and Ingall, O. D.
Forest Conditions in Illinois.
Bul. Ill. State Lab. Nat. Histy., vol. 9, art. 4, 1911.

Kauffman, H. G. and R. H.
Historical Encyclopedia of Illinois and History of Ogle County.
2 vols., Chicago, 1909.

Kincer, J. B.
Seasonal Distribution of Precipitation and Its Frequency and Intensity in the United States.
Month. Wea. Rev. 47:624-33, 1919.

Leverett, F.
The Illinois Glacial Lobe.
U. S. G. S. Monograph No. 38, 1899.

Pool, R. J.
The Invasion of a Planted Prairie Grove.
Proc. Soc. Am. For. 10:1-6, 1915.

Salisbury, R. D. and Barrows, H. H.
The Environment of Camp Grant.
Ill. State Geol. Surv. Bul. 39, 1918.

Schwarz, G. F.
The Diminished Flow of the Rock River in Wisconsin and Illinois.
U. S. Dept. Agric. Bur. of Forestry, Bul. 44, 1903.

Shreve, F.
A Map of the Vegetation of the United States.
Geog. Rev., 3:119-25, 1917.

Transeau, E. N.
Forest Centers of Eastern America.
Am. Nat. 39:875-89, 1905.

Waller, A. E.
Crop Centers of the United States.
Jour. Am. Soc. Agron. 10:49-83, 1918.

Ward, R. deC.
Rev. Kincer, J. B. Month. Wea. Rev. 47:631-2, 1919 art. in Scien. Month. 9:210-23, 1919.

Weaver, J. E. and Theil, A. F.
Ecological Studies in the Tension Zone Between Prairie and Woodland.
Univ. Neb. Bot. Surv., 1:1-60, 1917.

ACKNOWLEDGMENTS

Thanks are especially due to Mrs. R. H. Kauffman of Oregon, Ogle County, for her public-spirited kindness in furnishing a great deal of data in addition to that in her history of the county, and to Mr. Charles D. Etnyre, also of Oregon, for his assistance in furnishing information for the writer in the field, and to Mr. F. G. Taylor, of Oregon, the Superintendent of Schools, for his kind assistance in the field.

Mr. C. J. Root, Chief of the State Weather Bureau, U. S. Department of Agriculture, at Springfield, Illinois, has kindly supplied data and information relating to the northern part of the state.

The State Soil Survey, Urbana, Illinois, has also kindly supplied information relating to the unpublished soil survey of Ogle County.

Thanks are due to Dr. Henry C. Cowles and Dr. George D. Fuller of the University of Chicago, Department of Botany, for their assistance and advice.