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The Forestal Conditions

AND

Silvicultural Prospects

OF THE

COASTAL PLAIN OF NEW JERSEY

WITH

Remarks in Reference to Other Regions
and Kindred Subjects

BY

JOHN GIFFORD, D.C.Ec.

FROM THE

Annual Report of the State Geologist of
New Jersey for 1899.

TRENTON, N. J.:

MACCRELLISH & QUIGLEY, STATE PRINTERS, OPPOSITE POST OFFICE

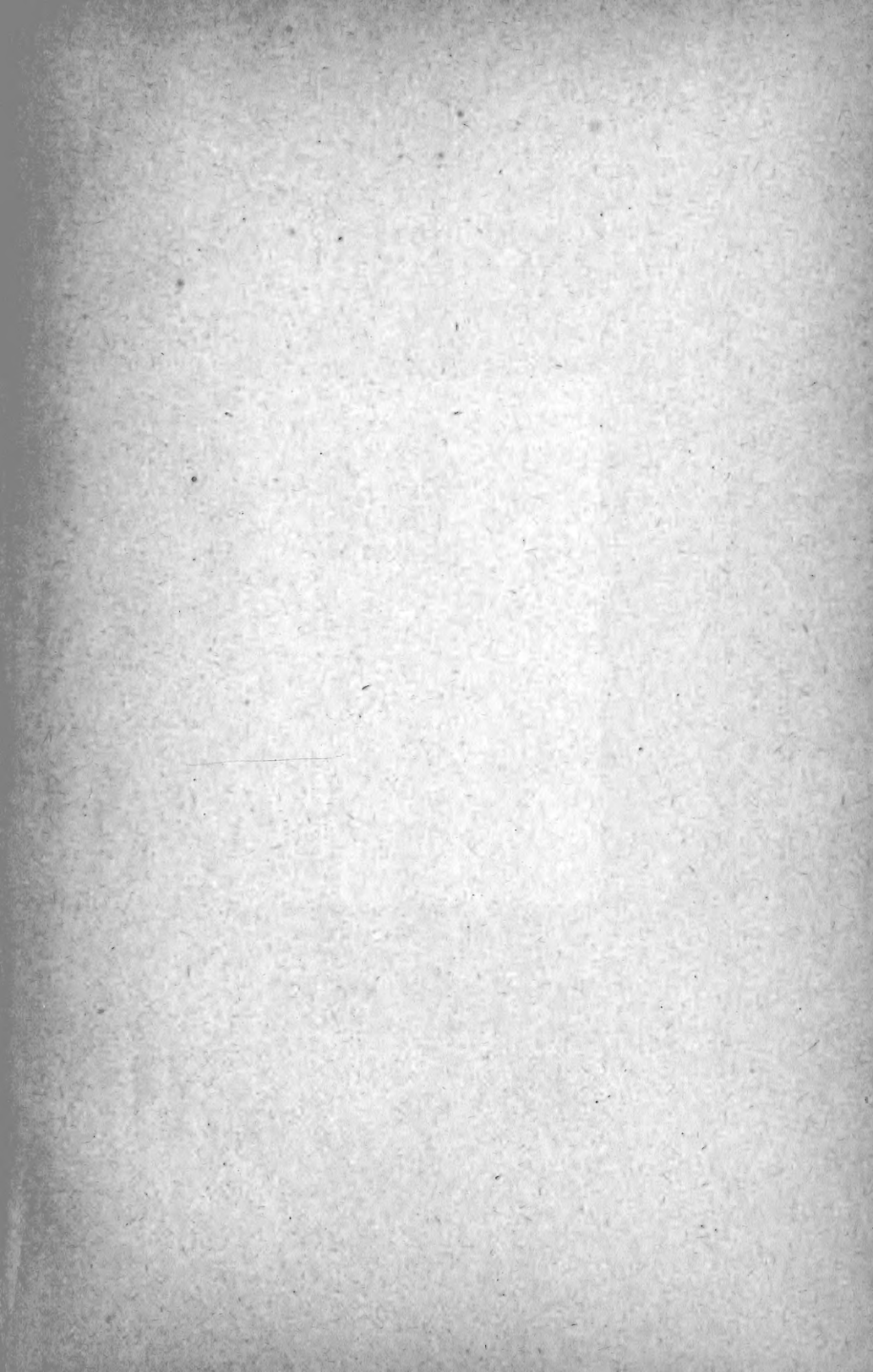
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GEOLOGICAL SURVEY OF NEW JERSEY
REPORT ON FORESTRY

Plate No. XVII.



ENTRANCE TO THE PHEASANTRY OF COMPIEGNE, FRANCE.

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Forestral Conditions and Silvicultural Prospects of the Coastal Plain.

I. General Description.

Although small in area, the State of New Jersey is very varied in nature.* In the north there are rough, wooded mountainous regions; in the central portions rich farm lands, and in the south vast stretches of sandy pine-lands. The average value of improved land in New Jersey is higher than that of any other State in the Union. The State is without a rival in reference to location and transportation facilities. If forestry cannot be practised with profit in this region, there is little hope for it elsewhere in eastern America.

The region to which this title refers is located in the southeastern portion of the State, less than one hour's ride by train from New York and Philadelphia.† It is irregularly triangular in shape, and is included between latitudes $40^{\circ} 20'$ and $38^{\circ} 55'$, and longitudes 74° and $75^{\circ} 30'$.‡ It is the northern extremity of the Atlantic Coastal Plain, which extends southward in vast stretches of sandy pine and swamp-lands, to the cocoanut groves and pine-apple fields of Florida. The Coastal Plain of New Jersey is bounded on the southeast by the Atlantic Ocean, on the southwest by Delaware Bay, and on the northwest by a comparatively thickly populated and productive agricultural region. The area of this territory is about 2,500 square miles, at least

* The area of New Jersey is 8,224 square miles, with a population in 1895 of 1,672,942. The area of the Grand Duchy of Baden, an important forest state of the German Empire, is 5,821 square miles, with a population of 1,657,867. It is considerably smaller than the Kingdom of Belgium, which contains 11,373 square miles, with a population of 6,195,355.

† The combined population of adjacent cities amounts to more than five millions!

‡ This region lies in about the latitude of Naples, Constantinople and Northern Japan. Although South Jersey has the temperature of Northwestern Europe, it enjoys the sunshine of Italy.

seventy-five per cent. of which is woods.* It is slightly rolling in nature, seldom exceeding two hundred feet above the level of the sea, and is traversed by several navigable rivers † besides many small streams.

The climate of this region, although close to the ocean, is, in comparison with that of Western Europe and the Pacific coast, dry. Our prevailing winds which come from the west are dry. During the hot, dry days of midsummer even wild bushes often die. On the other hand, the destructive effects of strong winds, frost and snow press are very slight.

The East American life zones, each characterized by certain forms of life, extend westward with exceedingly irregular and broken borders. There is a transition belt in which the North and the South more or less overlap. This is the true agricultural part of Eastern North America, where apples, white potatoes, barley and oats attain their highest development. It is where the oak, hickory, chestnut, liquidamber, white cedar, etc., of the south, meet the white pine, maple, beech, birch, hemlock, tamarack and arbor-vitae of the north. South of this transition belt begins the first of the true Southern zones, the Carolinian, to which the Coastal Plain of New Jersey belongs. ‡

A very large percentage of the Carolinian life zone is forestal. Owing to its immense size and to the nature of the agricultural crops which it produces, and for which there is only a limited demand, a large proportion of this zone is destined to remain in forest for many years to come. The Boreal and Austral zones are forestal, the Transition zone agricultural. The eastern part of the Transition zone, from the Dakotas to the sea, although at

*The term "forest" is seldom used by woodmen. Good or bad, big trees or bushes, it is all called "woods," which is a good generic name for such nondescript lands. The word "forst," from which comes "forest," is a pure Germanic word. From the earliest times it has been applied however to woods which have been protected and regulated.

† It is easy to secure an abundance of water in this region, which is a very important feature from a cultural standpoint. In addition to many streams, a natural copious flow may be obtained from artesian wells, so that in places irrigation is easy and practical.

‡ The Coastal Plain of New Jersey is a northern extension of the Carolinian belt into the Transition Zone. It is in reality a part of the South in the North, and as Prof. Merriam says: "When such farms occupy suitable soils in thickly inhabited regions, so their products may be conveniently marketed, they are of more than ordinary value, for the greater the distance from its area of principal production a crop can be made to succeed, the higher price it will command. Hence, farms favorably situated in northern prolongations or islands of southern zones, or vice versa, should be worth considerably more per acre than those situated within normal parts of the same zones. The obvious reason is that by growing particular crops at points remote from the usual sources of supply, and at the same time conveniently near a market, the cost of transportation is greatly reduced and the profit correspondingly increased."

present agricultural, was formerly the great white-pine region of North America. The white pine of the Transition zone and the short-leaf pine of the Carolinian zone meet on the edge of the Coastal Plain of New Jersey.

The Carolinian zone is characterized by the short-leaf pine (*Pinus echinata*), sassafras, persimmon, liquidamber, magnolia, white cedar (*Chamæcypris thyoides*), cardinal bird, opossum,* grape, English walnut,† sweet potato, etc. On its southern borders the long-leaf pine (*P. palustris*), the old-field pine (*P. taeda*),‡ the bald cypress (*Taxodium distichum*) and the southern magnolias appear. In this zone§ the white cedar (*C. thyoides*) and short-leaf pine (*P. echinata*) reach their optimum. ||

Throughout the entire mainland of the Coastal Plain of New Jersey very light sandy soils predominate, although there are many beds of heavy clay, and ridges of road-gravel, also sand and clay loams and vast stretches of mucky swamp-lands. The higher portions of the upland are usually gravelly, the intermediate sandy, and the lower, loamy and clayey. The farther south the richer the soil and of course the thriftier the forest growth. The gravel is yellow and consists of small water-worn quartz pebbles mixed with sand and clay. When of the proper

* The opossum (*Didelphys virginiana*), about which so much has been written because of its marsupial pouch and peculiar habit of feigning death, is arboreal in habit, with hand-like feet and prehensile tail, and is fond of the fruits of the persimmon tree, the seeds of which it is instrumental in distributing. It is highly esteemed as food, especially by the negroes of the South.

† East of the Rocky mountains the Persian walnut has been most successful in a limited area along the Atlantic coast from New York southward through New Jersey, southeastern Pennsylvania, central Virginia, North Carolina and Georgia. Farther south it does not succeed, owing mainly to the deprivations of microscopic worms, which cause a disease commonly known as "root-knot."

‡ One specimen of *Pinus taeda* was discovered by Mr. Pinchot, and another by Mr. A. H. Hollick, in Southern New Jersey. The region of the Pokomoke river, on the peninsula between the Delaware and Chesapeake, is, as far as I have been able to observe, the most northern limit of the natural growth of the bald cypress.

§ According to the investigations of the U. S. Biological Survey (see "Laws of Temperature Control of the Geographic Distribution of Terrestrial Animals and Plants," National Geographic Magazine, Vol. VI, December, 1894), the northward distribution of terrestrial animals and plants is governed by the sum of the positive temperatures for the entire season of growth and reproduction, and that the southward distribution is governed by the mean temperature of a brief period during the hottest part of the year. According to Prof. Merriam the species of the Carolinian belt require a total quantity of heat of at least 6,400° C. or 11,500° F., but apparently cannot endure a summer temperature the mean of which for the six hottest consecutive weeks exceeds 26° C. or 78.8° F. The northern boundary of this zone, therefore, is marked by the isotherm showing a sum of normal positive temperatures of 6,400° C. or 11,500° F., while its southern boundary agrees very closely with the isotherm of 26° C. or 78.8° F. for the six hottest weeks. The minimum temperature was assumed to be 6° C. or 43° F., that is, the point where metabolic processes are just possible.

|| By optimum is meant the combination of conditions that produces the best average result.

mixture and consistency, it is an excellent and inexpensive road material. The abundance of such gravel in a country where the natural roads are bad is a fortunate coincidence. When sand and gravel are cemented together by compounds of iron, as is often the case, a durable conglomerate is formed, which is the principal building-stone of the region.

The sources of the rivers of the Coastal Plain are on its northwestern edge. The land slopes gradually to the sea, and is so level that tide-water penetrates far into the interior. Drainage is therefore good, and stagnation of standing water only occurs here and there in places which are underlain with an impermeable hardpan.

The Plains* are extensive, practically treeless regions in the northern part of the Coastal Plain. The region called the East Plains contains 6,662 acres, and the West Plains 7,737 acres. There are other areas of the same nature, so that 20,000 acres is a conservative estimate of the amount of land of this kind. These Plains are hilly, about one hundred feet in height, and with gentle slopes. The surface soil is usually a bleached sand. Often there is a subsoil of clayey loam and gravel at varying depths. Often the subsoil is hard-pan, and in places there are beds of conglomerate and strata of clay. There is practically no physical difference between the soil of the Plains and the soil of thousands of acres in the neighborhood on which trees of good dimensions are growing. Owing to the hilliness of the region in comparison with the surrounding country, and owing to the lack of a more extensive cover, the soil has been subjected to the leaching and beating of rain and the scorching and drying effects of the sun and wind. One would expect to find it, therefore, exceedingly poor in quality, with a dearth of plant food, which might, at least in part, account for the absence of a more

* The term "plain" is usually applied to broad stretches of country which are level or undulating. Owing to the fact that vast treeless areas in the West are called "The Plains," treelessness is popularly associated with the word "Plain." For this reason, no doubt, certain treeless regions in New Jersey are called "The Plains," although they are hillier than the surrounding country. Geographers, however, apply the term to level regions regardless of their cover; for instance, "the Atlantic Coastal Plain." It is worthy of note in this connection that the people of the West distinguish between the "Plains" and "Prairies." The term "Prairies" is applied to the region between the 104th meridian and the eastern base of the Rockies. Their treelessness is mainly due to a lack of moisture. East of this are the "Plains," a fertile but formerly treeless region. The absence of trees is here due rather to the extreme fineness of the soil or to fire and grass than to moisture conditions. Wherever a plain is produced by fire reforestation is possible, but in regions where treelessness is due to a lack of moisture, afforestation is difficult and often impossible without irrigation.

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extensive growth. A chemical examination disappoints one in this respect. Very little dependence, however, can be put in the analysis of a soil. Although the essential ingredients may be present in sufficient quantity, they may not be in available form. A soil may be physically and chemically good, but if moisture is insufficient, the forest will be light and commercially of little importance.

The Plains are covered with a low bushy growth of several species. The highest tree (a sassafras) measured in this whole region was fifteen feet (four and one-half metres). The most peculiar feature of this area is the fact that a large part of the growth is a coppice of pine. By the natives these short, stunted pines are called "she-pines."* They are the stump-shoots of *Pinus rigida*, commonly called the rough-bark or pitch-pine. When this pine is cut many shoots sprout from the stump, but since insects soon attack and devour it, the young shoots usually die in consequence while still small and tender. There is a strong tendency in the pitch-pine, *Pinus rigida*, to send out shoots, especially when growing under adverse conditions. Soon after a fire, with the foliage completely burned, and the bole girdled, many dormant buds in the crown and on the trunk develop into shoots, which soon, however, wither and die. Even logs which have been cut and hauled to the mill send out similar shoots. These, of course, wither and die just as soon as the starchy materials and moisture in the trunk are exhausted. The poorer the soil, and more adverse the conditions, the stronger seems the tendency to sprout from the stump. Sprouting in this way is rare among the conifers, and, although of interest botanically, is commercially of no significance whatever. Ordinarily a pine coppice is short-lived, but on the Plains it has persisted for many years. Fire sweeps over this region frequently and burns the shoots while still only a few feet high, but the stump, gnarled, charred and full of pitch, continues to live. Some of the stumps appear to be more than

* The term "she-pine," or "she-pitch-pine," is also applied to *Pinus heterophylla*, which grows in the region of the Gulf of Mexico. In the language of the natives, the prefix "she" indicates not sex but inferiority and imperfection. *P. heterophylla* has been regarded by the lumbermen as a tree of very inferior quality and of little value in comparison to the true southern pitch-pine, *P. palustris*. In the same way the term "she balsam-fir" is applied to *Abies fraseri*, a small, short-lived tree which inhabits only the high slopes of the Alleghany Mountains in Carolina and Tennessee. For the same reason the adjective "bastard" is often applied to trees.

red cedar (*Juniperus virginiana*) and holly (*Ilex opaca*) appear as forerunners, the seeds of which have been dropped by passing birds. The persimmon and sassafras, hardy oaks, and wild-cherry (*Prunus serotina*) also spring up, and near the sites of old dwellings are clumps of the tree-of-heaven (*Ailanthus glandulosus*) growing with tropical rankness, root suckers from the old trees which were once in favor for shade and ornament; now and then also an old sycamore with serpent-like limbs; here and there pines appear, the edges gradually close in on the field, the solitary forerunners become surrounded by their progeny, the gaps are slowly filled by whatever may chance to fall by the many natural means of seed distribution. Thus, in time, the whole becomes a mixed forest of many species and of all age classes: here a thicket, there a pole-wood consisting of softwood and hardwood, evergreen and deciduous sorts, many sickly suppressed trees and many much branched, rough and knotty trees which were the forerunners, holding their own in the struggle for life even against their own progeny. Soon come axe and fire; the weaker kinds perish, the best are used, and a few pines and a coppice of hardy oak alone remain. Sometimes, if surrounded by pine, these old fields come up in a growth of pine as thick and green as a field of grain.*

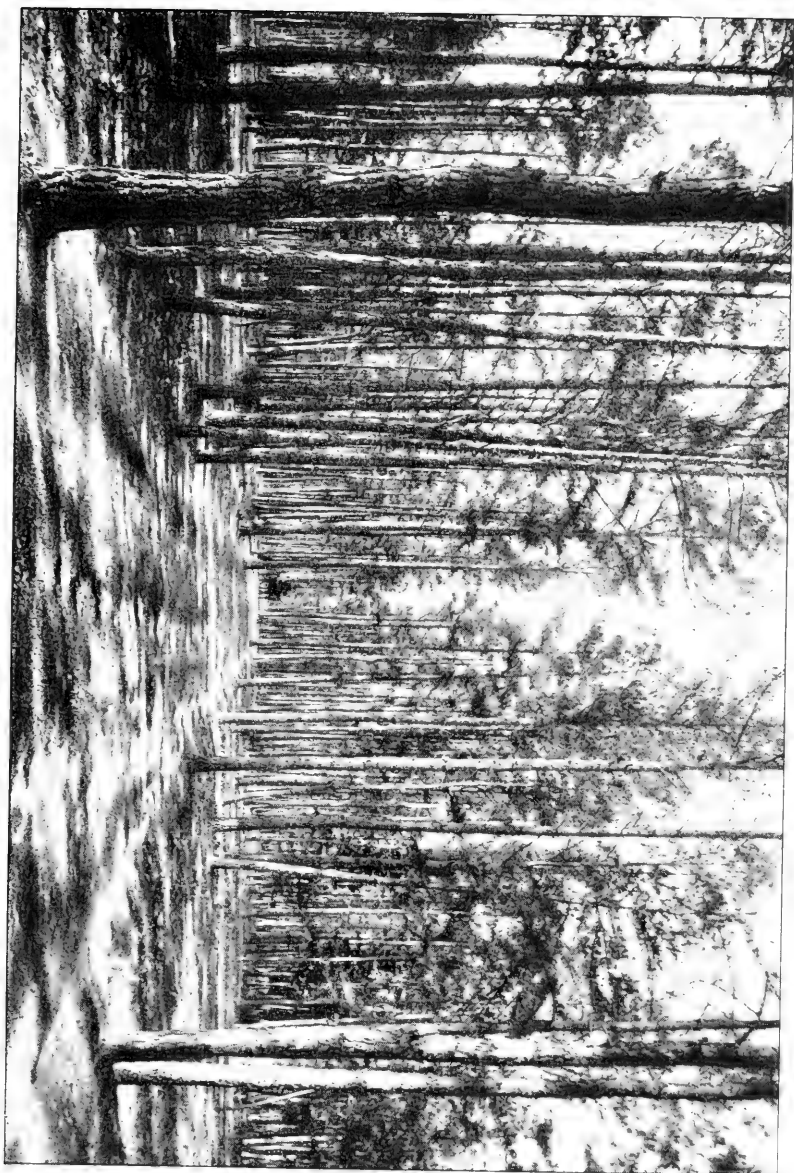
The forests of the eastern United States are possessed of marvelous regenerative power: Among the hundreds of native species there are many capable of great endurance, and, indeed, in the regions east of the western prairies there are few spots so sterile and inhospitable that one or more of these species cannot survive. There is abundant material for the development of new and elaborate systems of silviculture suited to the conditions and needs which exist.

A very large part of the Pine-Barren district is oak coppice. The area in pine, however, is constantly decreasing, the area in oak increasing. Oak of some kind almost invariably follows

*One must not too hastily conclude that the majority of the Jersey pines are pitch or Indian pines (*P. rigida*). A careful census of many districts will show, especially in the southern counties, that the short-leaf pine predominates. Although the pitch-pine endures fire to a greater extent, the short-leaf pine is more prolific. From a forestal standpoint, this is, in spite of everything, a hopeful condition of affairs, because, as I shall endeavor to show later, there is no coniferous forest tree of the dry sandy portions of the Carolinian zone which is silviculturally and commercially the equal of *Pinus echinata*, the short-leaf or smooth-bark pine.

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THE PINES AT LAKEWOOD

pine. Throughout every pine woods are scattered here and there suppressed oaks, the seeds of which may have been dropped by jays or chickarees. Just as soon as the pines are cut, these oaks, owing to increase of light and room, grow quickly. In spite of the poverty of the soil and the inroads of insects, and although burnt and cut again and again, they show remarkable vigor.*

Even scientific men have advanced the theory that one species of tree follows another because the first exhausts certain ingredients in the soil which it must have and which another species may not need. Such statements are rarely founded on facts. The reason one species follows another may be easily determined in almost every case with a little observation and study. Trees do not generally exhaust the soil, but, by bringing inorganic materials from deep layers of the soil and depositing these in the form of litter on the surface, and by protecting it from the beating and leaching of rain and scorching effects of wind and sun, improve its quality. In moist pine regions which have been burnt over several times and on which everything is killed, birch often springs up in an almost magical way. This is due to the facts that the seeds of the birch are quickly distributed by the wind and quickly germinate, and that the birch is capable of living on extremely poor soil.

Many dry leaves cling to the small oak trees until the following spring; † the limbs reach close to the ground, and fire, therefore, in the late winter or early spring, before there is much sap in the wood, kills them, although the stumps live on, and with great persistency produce a fresh growth. In the struggle for existence the scrub oak and the black jack (*Q. marilandica*) usually survive. Although these two oaks are of slight economic importance, it is due to their pertinacity that in many places the soil has been prevented from shifting. The species which form this coppice are, post oak (*Q. minor*), black oak (*Q. velutina*), white oak (*Q. alba*), chestnut oak (*Q. prinus*), Spanish oak (*Q. digitata*), red oak (*Q. rubra*), black jack (*Q. mari-*

* It is well known, however, that oaks, chestnuts, and similar trees, lose their vitality when asexually reproduced for a great length of time.

† It has been suggested by botanists that these clinging leaves indicate a tendency or are a step toward the evergreen state. The magnolia glauca is almost evergreen in Southern New Jersey. When leaves cling in this way it is an indication that the species is frost-tender and that the leaves were injured by frost before the normal corky layer was formed at the base of the petiole.

landica), and scarlet oak (*Q. coccinea*). Hybrids and irregular forms are common. The coppice is usually cut as pole-wood for fuel, and has little value. Owing to careless cutting the stumps are apt to be partly decayed. This decay spreads to the tree. It also invites the inroads of insects, the number of which injurious to these oaks is legion.

The wonderful rapidity of tree growth in this sandy soil is often remarked with surprise. Bleached white as snow, and, apparently, absolutely destitute of plant food, it is nevertheless capable of supporting a thrifty arboreal growth. The young tree starts with the greatest difficulty and languishes throughout the early part of its life, but as soon as its roots have reached the deeper and richer layers of the soil it starts afresh and grows thenceforth with astonishing rapidity. The soil is porous, and although well drained, is moist a short distance below the surface. The lay of the land and the nature of the soil is such that the roots of trees can in the majority of cases penetrate to where there is constantly sufficient moisture. From the Plains, the highest part of the Coastal Plain, there are naturally all degrees of soil-moisture conditions, through the Pine Barrens to the swamp lands.

A swamp is usually defined as a tract of land with or without trees, lower than the surrounding country, and so saturated with water as to be unfit for cultivation.

This definition, however, is insufficient. When one speaks of a swamp in Southern New Jersey, or in any part of the South-eastern States, a wooded region is usually meant. A swamp, also, is not always unfit for cultivation. Some of the best farm land in America is on swamp bottom. Neither is it always lower than the surrounding country. Elevated swamps are common, and the Dismal Swamp of Virginia and North Carolina, which is like a Jersey swamp in many respects, is several feet higher than the surrounding country, with a lake in the center from which water runs in all directions.

The amount of water in a swamp is an important matter, also the temperature of the water. It varies in amount from a degree of mere moistness to the condition of the Cypress swamps of the south, which are at times navigable for canoes, bateaux and often good-sized scows. Along the Mississippi river there is a vast

region called the River-swamp, which is seldom completely flooded. Here, several of the trees which grow in southern New Jersey reach their optimum. Many trees which thrive in water in the south cannot live in the swamp-lands in the north, because of their coldness, but thrive on the upland. By the term swamp is merely meant a wet, muddy region, covered with a wild growth of trees and bushes.

To wet, almost treeless or treeless areas, the terms savanna, morass, bog, slough and marsh are applicable. The term savanna is usually applied to lowlands covered with grasses and other herbaceous plants; the terms morass and bog, to extremely spongy, sphagnaceous lands; and the term marsh, to the soft, muddy deposits around and along bodies of both salt and fresh water. Some are inclined to restrict the term marsh to those areas formed in salt water. There is little reason for this, since salt and fresh marshes are essentially alike in formation. All these terms are, unfortunately, exceedingly elastic in meaning. A cedar swamp, for instance, is a swamp while covered with trees, but when cut over, cleared and planted with cranberries, it becomes a bog.

Much of the swamp-land in the Coastal Plain of New Jersey, although merely moist and extremely fertile, will probably remain in woods for many years to come, because of the difficulty in clearing it. A swamp bottom consists of the forest detritus of ages, and is a matted mass of roots, stumps and tree trunks.

The swamp-land may, for the sake of convenience, be divided into cedar swamps and deciduous or hardwood swamps.

The white cedar (*Chamaecyparis thyoides*),* the finest soft wood of the region, grows in dense pure forests. The tree is tall, straight and sharp-pointed. The bases of the crowns meet to form a solid canopy. The trees grow so close that one supports another, and when a few are cut, or felled by storm, others in the neighborhood, deprived of their support, fall in every direction. The limbs are often festooned with a gray lichen (*Usnea barbata*), the pendant tufts of which are favorite nesting places of the Parula warbler (*Compsothlypsis americana*). These

* This tree should not be confounded with the white cedar or arbor vitæ of the north (*Thuja occidentalis*).

swamps are warm and protected in winter, and harbor, therefore, many birds. They are cool in summer and fragrant with the odor of clethra (*C. alnifolia*) and magnolia (*M. glauca*). A cedar-swamp bottom seldom freezes. This may be partly due to the fact that cedar swamps are usually located in regions of springs.

The forest floor is usually covered with a thick mat of spongy sphagnum moss. The streams in passing through the swamps often separate into several streamlets, which meander through the mass of moss and submerged tree trunks and roots. The water of these in dark places is black as ink, but in the light and in shallows is the color of mahogany or amber, owing to impregnations from the humus. Nothing is more characteristic of the Coastal Plain of New Jersey than these swamps of cedar. Although practically the northern limit of this excellent species, it is perfectly at home in South Jersey. Free from disease, and always a fresh rich green, cedar swamps form the most striking feature of the landscape. It is a common saying in South Jersey that a cedar swamp attracts a shower. It seems to be often the case that a thunder storm follows a branch or stream until it reaches a mass of swamp, and there drops its rain.

Owing to the excellence of the wood, these swamps are devoured with avidity by lumbermen. The bottom when not too difficult to clear, and when properly located, is in demand for cranberry bogs.* When a cedar swamp is cut or burnt, if certain conditions prevail, it may come again in cedar, usually, however, deciduous swamp trees, inferior in nature, usurp its place.

*The cultivation of the large or American cranberry (*Oxycoccus macrocarpon*) is a very important industry in South Jersey. The berry, the size of a cherry, grows in large quantities on a low creeping vine, which forms a mat on the surface. The clearing and preparation of these bogs are expensive, but the yields are often enormous, and the bog lasts for many years without perceptible deterioration. The cultivation of this plant requires skill and experience. In times past fortunes have been lost as well as won in the cranberry industry. The amount of fruit yielded year after year by a bog suitably located and tended is often enormous. A cedar-swamp bottom through which there is a running stream is selected. This is banked and arranged so that the bog can be easily and quickly flooded, since it is desirable to keep it covered with water throughout the winter and for a short time at other seasons of the year, to protect it from frost, to drown out undesirable weeds and insect pests or prevent a fungous disease called "scald." A bog may be flooded at any time without injury to the vines, except when in blossom. In clearing a bog the stumps are usually removed, but not always. The whole is turfed with a cranberry or bog hoe, which has a wider blade than the ordinary grub-hoe. Ditches are dug throughout the whole bog, and sometimes the surface is sanded. It is planted in a simple manner with a suitable variety of wild-berry from the woods or from another bog. Usually the vines are mown down with a scythe. These pieces are dropped over the area ready for planting and pushed into the soft soil with a wooden dibble. They soon take root, and in the course of a couple of years their vigorous stolons have complete possession of the soil.

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A WHITE-CEDAR SWAMP



MAGNOLIA GLAUCA

The swamp lands* being moist, have naturally not suffered from fire as much as the uplands. They often consist, therefore, not only of a great mixture of species, but are a semi-tropical tangle of wild grapes, and other vines and bushes. The deciduous or hardwood swamps usually contain a mixture of the following trees of more or less importance: *Acer rubrum*, red or swamp maple; *Liquidambar styraciflua*, sweet gum or bilsted; *Nyssa sylvatica*, black or sour gum, and *Magnolia glauca*, or brewster, are the commonest. In some swamps there are beeches (*Fagus latifolia*), tulip trees (*Liriodendron tulipifera*), swamp white oak (*Quercus platanooides*), willow oak (*Q. phellos*), holly (*Ilex opaca*), sassafras (*S. sassafras*), and now and then a pitch-pine (*Pinus rigida*), a smooth-bark pine (*Pinus echinata*), a white cedar (*Chemæcyparis thyoides*) or even a white pine.†

Fire and the axe have converted many of these swamps into sorry looking thickets and cripples,‡ which are little more than tangles of saplings, bushes and vines. It is easy to imagine how, in the course of time, fire, burning over land of heavy nature or land which is usually moist, will gradually kill even swamp trees and shrubs, until nothing remains but herbaceous plants among charred stumps. These swamps often become very dry in summer, and the natives, to improve the quality of the berries (or very rarely the pasturage), set fires. This must be done, however,

* It is in these swamps where the animals of the woods take refuge, especially the deer, which, at a certain time of the year when the law allows, are remorselessly chased by packs of hounds. The extinction of this animal in New Jersey is only a matter of time unless the use of dogs is absolutely prohibited at all seasons. It is the prevailing opinion in the Adirondacks that the wisest move in the protection of deer was the prevention of hounding by law. The meat of a hounded animal is poor in quality, to say nothing of the cruelty which the nagging of dogs occasions. Hunting at best is an immoral sport, and in America is everybody's privilege. In every backwoods town there are local social gypsies or pothunters who love sport and hate work, who spend their days wandering in the woods with dog and gun, and their evenings in the country store or tavern relating their experiences. Several animals in South Jersey are hunted not for their pelts or for food but for the bounty which the townships very foolishly pay for the heads of certain so-called "depredatory animals," among the worst of which the fox is classed.

† The white pine was at one time quite abundant in Manahawken swamp. These pines towered high above the cedars of the swamp. This suggests the possibility of growing the white pine in such districts either alone or mixed with white cedar. The choppers whom I consulted at the time of my visit called the white pine "white wood."

‡ The term "cripple" is a localism used in South Jersey and on the Chesapeake peninsula. It is applied to a thicket or bushland. It is interesting to note that the Germans use the word in the same sense. For instance, a stand of trees which has been abused by careless cutting, etc., is called a "Kruppelbestand." Underbrush is sometimes called "Kruppelholz."

when the soil is not too dry.* In this way moist swamps become meadows. This land, if left to itself and protected from fires, soon recovers, but there is another kind of grassy land, namely "Savanna," which is of little worth in New Jersey at present, and destined to remain unchanged for many years to come.

The formation of such grass land in New Jersey is usually due to a hard-pan which is often only a few inches below the surface. Hard-pan is the name applied to a dense, almost impenetrable stratum of compacted material. It is generally soil in the process of becoming rock. In these savanna lands † it is bog-ore and organic materials cementing the particles of sand. It is covered by several inches of humus, which is saturated with water and is sour in consequence. Here and there on knolls in these sloughs, a pitch-pine grows, but topples over in the course of time, owing to the slight hold which it has upon the soil. The hard-pan is similar to the "ortstein" of Northern Europe and the "alios" of the French Landes. This stratum exists in all degrees of hardness, and often in sufficient quantities to prevent the growth of trees on considerable areas of land, but in a region where even good wood-land has little value, the comparatively small area of savanna is not worthy of much consideration, because the cost of drainage and preparation would amount to more than the land is likely to be worth for some time to come.

Stretching along the coast of Southern New Jersey and along the Delaware river, fringing the mainland and bays, and extending along the rivers far inland, are many miles of salt marshes. They are of course treeless.‡ In former times these lands were banked and cultivated much more extensively than at present. Owing to the difficulty of keeping the banks in order, they have in large part been abandoned. The marshes, endless to the eye,

* Constant burning causes deterioration of pasturage in the course of time. The weaker grasses are gradually killed. On salt marshes and wild meadows where the soil is very moist, so that the roots are not injured by fire, regular burning is a benefit.

† The term savanna is a relic of the Spanish in America and in general merely means a tract of level land covered with low vegetation, usually grass. It is used throughout the world in this sense. In old Spanish the word means a "sheet," and was originally applied to a flat snow-covered region.

‡ In places hardy shrubs and trees are gradually intruding on the marshes as they become by deposit higher and sweeter. In other places groups of trees may be seen which have been killed by too large a dose of salt water.

are intersected by many bays, salt ponds, thoroughfares and winding creeks. They yield thousands of tons of salt hay (*Spartina juncea*), and black grass (*Juncus gerardi*), which are extensively used for fodder and packing. It is transported on flat-boats or scows up the many rivers to the interior, and is also baled and shipped to the neighboring sea-shore resorts and cities. Owing to the fact that these marshes already yield a good income, that is, a fair rate of interest on the amount invested, and probably more than cultivated fields would pay, by producing year after year a good grade of hay without any labor except the reaping, and a little ditching now and then, it would be a precarious investment to bank and drain them as has been done with similar land in Holland, except in the northeastern part of the state, where proximity to cities makes land more valuable than in the southern part. These banked lands, although fertile, are unsatisfactory to till; the dykes are* a constant care and anxiety, and storms and high tides, besides other serious dangers, often cause irreparable damages.

The reasons for mentioning these marshes in this connection are, firstly, they yield an abundance of fodder and litter, and secondly, the mud is an extremely rich fertilizer, consisting mainly of humus, but containing also lime, and the decomposed bodies of both macroscopic and microscopic organisms. It is an inexhaustible store of fertility. In it are the materials which the sandy soil of the interior needs most. By applying this mud in the fall, so that the frost will pulverize and mellow it, and, the following summer, sowing a leguminous crop for green manure, the sandiest field is rendered so fertile that with intensive culture, including a regular supply of water and intelligent labor, it will produce fruits and vegetables of the finest

* The banks are often seriously damaged by the musk-rat (*Fiber zibethicus*), an aquatic rat-like rodent. It yields a salable fur and is extensively trapped. They dig through a bank in all directions, causing it to leak and weakening it throughout in a way which is difficult to repair. They are prolific and must be combatted in various ways. Many encourage the presence of black snakes (*Bascanion constrictor*), which feed upon its young. A tight hemlock board or slab-fence is often constructed against the face of the bank, or small pilings are driven close together along its outer edge. Ditches should never be dug on both sides of a dyke, if so, the rats are very fond of channeling from ditch to ditch. If sand is used in the construction of the outer part of a bank, rats are less apt to disturb it, because it caves easily and thus interferes with their digging. Willows should be planted on these banks and fascine and wattlework constructed on their faces. The great use of fascine and wattlework is not fully appreciated in America. The banks which worry the Jersey farmer would be little more than play to the enterprising Dutchman who, with patient toil, farms into the very jaws of the sea. He would even look with envious eyes on our shallow inland bays and would soon convert them into many acres of rich polder-land.

quality. This litter and mud are abundant and available to all those who have enterprise and energy enough to utilize them.

The mainland and marine marshes are protected from the action of the ocean waves by a line of barrier beaches or sea islands. These beaches, on which are located many famous resorts, are separated from one another by inlets through which the tide sweeps swiftly. Strictly speaking, a beach is that part of a shore between high and low water, but in New Jersey the term is applied to what are really sea-islands. These islands consist of a fine white sand which in places is mobile. When the tide falls, the sand of the beach proper, dried by the sun and wind, is blown either inland or into the ocean. The prevailing winds blow toward the sea, and the sand as it dries flies back into the water to be whirled again on the beach by the waves. If the wind continues for some time from the sea, sand-hills are formed. Any small obstacle sufficient to diminish the energy of the wind may cause the commencement of a dune. As soon as a little hill is formed, it is easy to see how it may continue to form while the conditions remain the same. Soon a strong west wind, however, may hurl it back into the sea, or an eastern gale fling it inland on the marshes. And so it goes, forming and re-forming, changing in fact with every caprice of the wind, gentle and almost unnoticeable during a light sea-breeze, but a stinging, blinding sand-blast in times of gale. In case of an obstruction, which interferes with the action of the wind, a dune forms equal in height to the obstacle. A great deal of the land on these islands is now occupied by resorts; it is all in fact owned by private parties, and is in places extremely valuable. But here and there are tracts of wild, shifting dunes. At Avalon there is a huge dune, caused by a dense forest which is being slowly but surely engulfed. The dune begins just above high-water mark, and then extends inland, gradually increasing in height until its summit is even with the foliage of the trees. It is a peculiar scene from the top of this dune; on the land side there is a dense mass of dark green foliage, beyond which there is the broad expanse of green salt marshes with their bays and thoroughfares.* On the ocean side, sloping to the breakers, there is a huge mass of fine sea-

* A waterway from one bay to another is called a "thoroughfare" along the Jersey coast.

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Plate No. XXI.



THE CREST OF THE SAND-DUNE ON SEVEN MILE BEACH

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Plate No. XXII.



HOLLIES ON SEVEN MILE BEACH

sand, out of which project the jagged trunks and limbs of smothered trees. The fine sand sifts into shoes, pockets, clothing and hair. It comes fresh from the great ocean-mill, ascends the surface of the dune, and falls over its crest into the forest. When a stiff breeze is blowing it skims along like drifting snow, and shoots from the summit of the dune, trimming the tops of the trees as flat as though shorn with shears.*

If these forests are what cause the dunes, by preventing the west wind from blowing back the sand, how did the forests form? Single trees here and there, or groups of trees, which are clean underneath, so that the west wind sweeps through without serious interruption, do not cause the formation of dunes. In the course of time, however, a thicket forms under these trees. They become covered with grape vines, Virginia-creepers and green-briars. The birds and winds scatter the seeds of many sorts of shrubs and bushes, such as *Prunus maritima*, sweet-gale, *Baccharis halimifolia*, etc., etc., until a dense forest is formed through which the west wind cannot penetrate, the consequence of which, in the course of time, is a dune, which in turn finally engulfs and kills the forest that had caused it.†

It is a mistake to suppose that this sand is sterile because it appears barren. True, it consists mainly of granules of quartz, but these are extremely fine, the interstices are small, and the capillarity great in consequence; mixed with it are particles of shells and other materials, organic and inorganic, which are in the ocean, working down the coast until washed ashore and shifted with the sand.

The forest at Avalon is so dense that many birds seek shelter there. The principal trees of these beaches are the holly (*Ilex opaca*), the red-cedar (*Juniperus virginiana*), the sour or black-gum (*Nyssa sylvatica*), magnolia (*M. glauca*), wild-cherry (*Prunus serotina*), hackberry (*Celtis occidentalis*), sassafras, swamp-maple (*Acer rubrum*), and a few oaks, and pitch-pines and even red-mulberry. The commonest, and by far the most characteristic, trees of the beaches are the holly and red-

* I am of the opinion that the shapes of trees along our coast is due more to the sand-blast than to the direct action of the wind. This also limits the number of species. Those plants with foliage best able to withstand this sand-blast are the ones which grow nearest the sea.

† By clearing away the underbrush and trimming the trees to let the west wind through, it might be possible in several places along the coast to dispel the dunes and prevent their future formation.

cedar. The holly thrives here, reaching a much larger size than on the mainland, apparently enjoying the moist, salt atmosphere and loose sand. It is a dune-tree par excellence. Its limbs are close and jagged, in striking contrast to the pyramidal, symmetrical holly trees of the inland open field. Its prickly foliage is dense and dark green, and its crown is flat. It produces rich red berries in profusion, and its bole is bright gray in color, rugged and sturdy. It is not uncommon to find two hollies grown together, or the limb of one tree growing into another tree, or a limb bending down and uniting with the trunk, forming what the natives call "jug-handles." Those who are familiar with the region will never forget these groups of hollies, nor the masses of aromatic red cedars with limbs festooned with gray lichens. (See plates XXI, XXII and XXIII.)

There is but little danger lurking in these sand-hills. They are, in this respect, unlike the dunes of Gascony, which, if robbed of their forests, would bury villages. The Jersey dunes are so wild and picturesque that many prefer to let them have their way; but the scenes on these beaches, so attractive and peculiar to-day, are destined to lose much of their charm by being transformed into resorts for recreation and pleasure.

How lacking in shade and attractiveness are our American sea-shore resorts in comparison with those of the Old World! Look at Arcachon (see plate XXVIII), for instance, with its summer village by the shore and its winter village of beautiful villas in the midst of a magnificent pine forest; or at the famous Dutch resort, Scheveningen, with its beautifully shaded avenues; or Domberg (see plate XXV), or anywhere, in fact, in the lee of the dune, which protects the farm-land where the industrious Dutch have beautiful villas in the midst of the woods. Sand-bars and mud-flats should never be despised, and a country close to the sea enjoys many advantages of which its people are not always conscious.

The utilization of the forests of America began with the Indian. The Coastal Plain of New Jersey, however, was very sparsely inhabited before Europeans landed. Here and there along the rivers may be seen the vestiges of Indian villages, pot-

* One often hears and reads the statement that the branch of forestry called "forest utilization" and "lumbering" are synonymous. This is a mistake in that lumbering is no more forestry than the picking of wild fruits is agriculture.

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Plate No. XXIII.



A GROUP OF RED CEDARS ON THE COAST OF NEW JERSEY



sherds, broken shells, bones and bits of jasper. At certain times of the year large numbers crossed the State to enjoy for a time the bathing and fruits of the sea, but the permanent population was never large. The Indian of New Jersey domesticated no animals and cultivated only a few plants. His clumsy stone implements were so unwieldy and impotent that he was unable to exterminate animals or cut down forests.* He depended mainly upon the fruits and animals of the woods. He needed only wood for fuel, which was everywhere plentiful, and white-cedar logs, out of which to shape his canoes. The rivers were his highways, the canoe his conveyance. Fires, no doubt, were set both accidentally and purposely by the Indian, but in Southern New Jersey they were probably infrequent, and did comparatively little damage. Indians in parts of Western America still fire the bush† to facilitate hunting. They desire open prairies and intervalles for their game. In many places east of the Mississippi river, after the Indians departed, prairie fires which they had purposely set every year, became less frequent, and forest vegetation in consequence began to appear in the open land.

He has left his impress upon the country however, and Indian words are indelibly attached to many localities, and to the names of many plants and animals, such as persimmon, chinkapin, hickory, tamarack, mahogany, pecan, etc.

Although the Algonquin Indian of New Jersey was dependent upon the forest and still in a primitive state, he cultivated small patches of maize and perhaps other vegetables, and was familiar with the edible wild plants. From the Indian the whites learned of a tree (*Acer saccharum*) with a sweet palatable sap‡ that grew

*"The chief use of the hatchets among the Delaware Indians of New Jersey," says Kalm, "was to make good fields for maize plantations. If the ground was covered with woods, they cut off the bark all round the trees with their hatchets at a time when they lose their sap. The trees thus girdled died, and the ground was a little turned up with crooked or sharp branches"

†The term "bush" is a peculiar one. It usually means a single low woody plant. In certain regions, however, it is applied to a wild forest with a dense underbrush. The sugar maple forest or orchard is sometimes called the "sugar-bush." The word in Dutch is "bosch," and means forest, and, no doubt, the Hollanders were the first to apply it in this sense in South Africa and America. The word "bois" in French and "bosco" in Italian are probably modifications of the same word. There is an old English word "boscaige," which means a thicket or woodland growth. In old English law boscaige meant food for cattle derived from trees or bushes, also a tax on wood brought into a city.

‡Col. Wm. Fox, in his paper on the maple-sugar industry, in the latest report of the New York State Forest Game and Fisheries Commission, says: "For our first knowledge of this product we are indebted to the North American Indian, the same people who gave us corn and tobacco. From the records of the earliest explorers on this continent it appears that the Indians tapped the maples, gathered the sap in rude receptacles, and boiled it. The first white settlers used the same methods, which substantially remain unchanged to day."

in the northern mountains. The settler, in times of famine, often appealed to the Indian, and many of the fruits and vegetables upon which he fed have been since neglected. The Indian-club and the Indian-fig, for instance, two of his important food-plants, are perhaps worthy of cultivation and improvement.*

The Indian of New Jersey was soon superseded by the settler, who, provided with two powerful implements—the axe and the gun—cleared small patches of land, and built cabins along the rivers. Trapping was the settler's first occupation and peltry † was one of the first and most important products of the virgin forest. Hunting and trapping in early times were hazardous, but often lucrative occupations. The forest was difficult to clear, and just as the young poplars to-day harass the New England farmer, by invading his pastures, and the mink and fox rob the hennery, so in early times a hundred-fold more bothersome were the suckers and seedlings, and animals from the woods between the clearings. Fire was freely used, and from the ashes potash was extracted by leaching. This lixivium, by mixing with grease produced soft-soap, which is still manufactured by country people. In many places to-day wood is extensively burnt for its ashes and used as a fertilizer.

Soon shipbuilding developed into an important industry. Oak and pine of the finest kinds were plentiful. Saw-mills were built along the streams, and lumber was shipped even to the West Indies in exchange for rum, sugar and molasses. The construction of schooners continued until recent times to be an important industry. Now, only small sloops, scows and bateaux are built. Ships of iron, propelled by steam, have superseded the clipper.

* It may often be the humblest and least conspicuous plants which yield the richest food materials, and not always the major forest products which, considering labor and time, yield the largest returns. The salep of Turkey and the truffles of France are excellent examples. Salep is a farinaceous food obtained from the tubers of wild orchids. It contains a substance called bassorine, which is very nutritious. Over \$3,000,000 worth of truffles are exported annually from France. They come mostly from Perigord, and grow in limestone regions on the roots of oaks.

† Several wild animals have, and perhaps others might be, profitably bred for their pelts. The skunk (*Mephitis mephitica*), one of the commonest and most disagreeable of all the animals of Eastern America, produces a salable fur called "Alaska sable," and in spite of the facts that it emits a nauseating odor and that a kind of hydrophobia results from its bite, has been kept in confinement and bred for its skin. The mink has been tamed and reared in minkeries in New York State. It has been said that a mink is as profitable as a cow. Coues, in his "Fur-bearing Animals of North America," says: "Were not fashion so notoriously capricious, mink pelts would maintain a conspicuous place in the fur-marts of the world; certainly few surpass them in richness of color, gloss and fineness."

Scattered here and there throughout the Pines are the remains of what were once centers of a flourishing industry. This was the manufacture of iron from bog ore (limonite). In some places the furnaces and forges have been completely obliterated and forgotten; in others only bits of black slag remain, while in others the ruins are still standing. These centers of industry, usually located in the neighborhood of streams and bogs, were connected by stage routes, along which here and there were clearings and taverns. Immense quantities of charcoal were consumed by these forges and furnaces, the owners of which usually possessed the land for several miles in every direction. Wood in those days was in demand, and coalings were frequent. Even after the iron industry in the Pines succumbed, charcoal was shipped to the cities by schooners in large quantities. Owing to the abundance of other forms of coal, the demand for charcoal has gradually decreased. Along the rivers there were many depots to which the charcoal was carted, which are still in evidence, owing to the great masses of coal-dust which accumulated there. Coal and iron were worked side by side in the neighboring State of Pennsylvania, transportation by rail increased the competition; the iron industry in the Pines was unable to survive, and with it faded the manufacture of charcoal,* and the value of coal-wood. The ruins of furnaces, the large dilapidated houses, the overgrown roads, the wharves, the piers, the old ship-yards, and the masses of coal-dirt on the landings are evidences of what the country was when iron was made from bog-ore, and when schooners were built to trade to foreign lands. The woods were full of men hewing timbers, cutting coal-wood, working in the coalings, raising bog-ore and carting materials from place to place. The death of these industries, however, is only the result of progress. In the development of the whole of a country, certain parts, although they may have once played an important rôle, must suffer. In the course of its development almost every country is subjected to a series of industrial ups and downs.

Another peculiar old-time industry was the mining of cedar. The bed of a cedar swamp is a mass of forest detritus, several

* It is unfortunate that so little charcoal is used in the American household. The fine flavor of French cookery is partly due to the use of an excellent quality of charcoal. Other kinds of coal and wood emit gases in the process of combustion which taint food more or less, and for successful broiling charcoal and the brazier are necessary.

feet in depth, in which there are logs of white-cedar perfectly preserved and excellent in quality. The white-cedar, like the cypress of the South, reaches a ripe old age. Over one thousand annual rings have been counted in buried stumps six feet in diameter, and, judging from fallen trunks, the age of these swamps is many centuries. It establishes the fact beyond a doubt that the white-cedar has been growing in South Jersey for ages, and that it is perfectly at home there in every sense of the word. The wood of many of these buried logs is sound and light. These were dug out, sawn into billets, and split by hand into what were called "mud-shingles," which last for many years.

It seems strange that the mining of cedar, when wood was plentiful, should be more profitable than at present, when white-cedar is scarce and poorer in quality. Lumber is cheaper in parts of Eastern America to-day, however, than it was a quarter of a century ago. This is due to the fact that a much wider field has been brought into competition by the development of railroads, and special long-distance freight rates from regions where timber is still plentiful, and where very complete, labor-saving, wholesale methods of working it are in practice.

The production of tar was not very extensively developed, and lasted only for a short time. The existence of the industry was due to the peculiar exigencies of the times. During the Civil War the North was deprived of necessary naval stores, for which the ship-handlers were willing to pay enormous prices. The natives of southern New Jersey took advantage of this opportunity and collected large quantities of "fat-pine knots," out of which they manufactured tar.

At one time the splitting of hoop-poles for barrel-hoops was an important industry. Coppice oak was used for the purpose.

* In "mining" cedar logs a great deal of skill and experience was required. Of course, many of the trees in the swamp were worthless when they fell. The person in search of shingle logs, therefore, first sounds the swamp-bottom with an iron rod. When he finds a solid log, he notes its position, size and length. With a sharp spade and axe he cuts down to it, in order to secure a chip of it, from which he is able to tell, especially by the smell, whether it was uprooted by the wind or broken off above the ground. In the first case it is apt to be much sounder and better. If satisfactory, he digs a trench along its length, and saws it off at both ends. The hole he has dug soon fills with water, and, after the log has been completely loosened, it rises and floats, being surprisingly buoyant. It turns over also, at the same time, being lighter and fresher in appearance on the underside. It is then rolled out of the bed where it has rested many years, is sawn into proper lengths, and split into shingles. There is still, no doubt, buried cedar in the swamps of South Jersey, but although fine in quality, it requires so much labor to work it that it is no longer profitable.

Owing to the substitution of bags for barrels and iron for wooden hoops, there is practically at present no demand for hoop-poles. At one time many people found employment in gathering the leaves of the upland sumac.* These were ground at the mills and were used for tanning.

The principal industries of the present are the cutting of wood for fuel and the working of timber for constructive purposes. Several minor products of more or less importance are also collected.

Wood for fuel may be divided into two classes—pole-wood and cord-wood. When small-sized trees are cut in the pole stage, such as oak coppice, they are merely stripped of their branches, and are not divided into regular lengths, and are sold as pole-wood, which is consumed locally and bought and sold by the one-horse or two-horse wagon-load. This wood is abundant and has little worth. If killed by fire, as is often the case, it is not seriously injured for fuel, although slightly charred, and often disagreeable to handle. Large quantities of this wood may be had for the asking. The person who sells pole-wood usually receives little more than his labor is worth in cutting and delivering it to the purchaser.

Cord-wood† is cut into sticks four feet long, and split once. It is usually either pure pine or oak, sometimes mixed. If located near a railroad or along a good wagon-road, there is a slight margin of profit in this wood. In many parts of the Coastal Plain of New Jersey it has no worth, because the cost of cutting and transportation is equal to or even more than the market price. Often, however, if the owner has teams of his own, he cuts the wood when slack of other work and transports it in order to furnish himself with labor. His wood-land really has

* The chestnut oak (*Quercus prinus*) furnishes the best tanning material of eastern trees. It is hardly safe to recommend the planting of trees for tan-bark owing to the fact that other means of tanning are in process of development, and new and perhaps better methods are liable to replace the old. There are a few people, however, who believe that oak bark will be worth more a few years hence. The use of quebracho, from South America, has had an important effect on this industry, but quebracho wood and hemlock will not last forever. The chestnut-oak is common in South Jersey, and one should have no hesitation in planting it. It grows fairly well in the shade of pine trees. In spite of the use of many other tanning materials, the choicest leather is "oak-tanned."

† A cord, in Jersey, is four feet wide, four feet high and eight feet long. It contains eight cord feet or one hundred and twenty-eight cubic feet, or 3.62 cubic meters.

little intrinsic value.* It is merely a means to an end. It pays, however, to convert the straight limbs and tops of trees, from which saw-logs have been cut, into cord-wood. South Jersey has to compete in the production of cord-wood with the woodland along the rivers of the neighboring States of Delaware, Maryland and Virginia, where a large negro population exists, which is skillful with the axe and willing to work for small wages.

The production of fuel-wood in South Jersey, however, will always take care of itself. Woods should be managed, therefore, with saw-stuff in view. Good lumber† is scarce and high in price, while fuel-wood‡ has practically no value whatever.

Much could be said of chopping in general, and the implements and methods in use of felling and converting trees. The American axe, the most perfect and useful of ordinary implements, is worthy of a chapter in itself. Intelligent chopping should be classed as skilled labor; in fact, by a judicious use of the axe in the hands of a person with an exact knowledge of the conditions which obtain, it is often possible to bring order out of chaos and correct the work of careless slashers.§

It requires only a short space to describe the handling of timber in South Jersey. There is no rafting, no skidways, no lumber camps. All this belongs to the past, when ship-building

*A few years ago wood was sold in Philadelphia from South Jersey for the purpose of dry distillation. There are several establishments of this kind in neighboring States. I fail to see why this industry could not exist in South Jersey as well as elsewhere. It is an industry which would use the rough wood, for which there is no market, and which rots in the forest. There are many dry distillation plants in New York and Pennsylvania, and the demand for the product is constantly on the increase.

†The terms "timber" and "lumber" are used in a peculiar way in America. Lumber means sawn stuff in merchantable form. It means also disused articles or discarded goods of any kind, and, according to some authorities, it is a modification of the word Lombard, the Lombards having been, in early times, famous pawnbrokers. Although the word lumber only means sawn or dressed stuff, the term lumberman is applied to a forest proprietor, a lumber merchant, or a worker of timber. Timber is applied to large-sized sawn or dressed stuff, and to the forest of trees large enough to produce such material. Such a forest is designated "standing timber." "Timber-culture" is used instead of silviculture, and the term "stumpage" means standing timber, considered with reference to its value for cutting, so called because the amount cut is ascertained by counting and measuring the stumps.

‡A chopper should cut the tree close to the ground, leaving a clean-cut sloping or roof-shaped stump. This lets the water off, prevents decay, and produces a vigorous coppice. The slashings should be piled in open places and burnt where there is no danger of the flames injuring neighboring trees. Always protect the young growth, favor the most useful kinds, and never forget that they are the materials from which the future forest is formed.

§It would be difficult to find an apter term for the common run of wood-choppers than "slashers," and the lumbermen themselves have aptly applied the term "slashings" to the immense piles of rubbish which they leave in their wake. It is this slash which brings disaster to the woods because of its great combustibility.

was an important industry. The writer can just remember the long line of mule teams, bound to the shipyards on the shore, with long straight stems of the oak and smooth-bark pine. The logs are now, usually, short and small, the roads are good and level, so that with the help of a couple of skids, cant-hooks and parbuckles the handling of logs is a simple operation.

The saw-mills are simple in nature and only work lumber for local demands, finding, however, in the resorts along the shore a good market for building materials.

The income from the gathering of wild fruits is probably equal to, if not more than the yield from fire-wood. The most important of these are the cranberry, huckleberry and blueberry.

The cranberry (*Oxycoccus macrocarpon**) is now extensively cultivated. It keeps well throughout the winter, and forms a rich crimson sauce, which is relished with turkey. Large quantities of these berries are exported to other States, and even to foreign countries.

The high-bush blueberry† (*Vaccinium corymbosum*), which reaches perfection in the swamps of South Jersey, has never been cultivated. It is preferred by many to all other wild fruits. It reaches the dimensions of a large shrub, if not a small tree, on rich, moist, loose soil. The quality of the berries can be easily improved by trimming. The natives know this and accomplish it in a drastic, wholesale fashion by firing the woods. The young shoots which spring up after a fire bear large luscious berries.

The wild grapes are also abundant. The fox grape (*Vitis labrusca*), is plentiful in the swamps, the vines of which often form luxuriant tangles in the tops of the trees. The fruit is dark purple or amber in color, with a tough pulp, but delicious musky aroma, and famous for jelly.

The persimmon tree (*Diospyros virginiana*) bears an abundance of rich fruit. The improvement of this fruit by grafting has begun. At present, when a little green, the fruit is puckery; when ripe, too soft; it is also too small and has too many seeds.

* The term "cranberry" is properly restricted to the genus *Oxycoccus*, the term "huckleberry" to the genus *Guylussacia*, and the term "blueberry" to the genus *Vaccinium*.

† White or pink varieties are not uncommon, which are simply cases of albinism. These are very sweet and worthy of propagation.

It contains, however, a larger amount of nutritive matter than other fruits, and is excellent for pies and puddings.*

The beach-plum (*Prunus maritima*) grows in sea-sand, close to the ocean, and in the driest, most inhospitable places, and at the same time bears a large crop of plums, which are excellent in flavor. It is only a shrub, but well worth planting in sandy regions. In addition to the above fruits there are many others of more or less importance for food, flavors and wines.

The floor of a cedar swamp is usually covered with a mass of sphagnum-moss. This is collected, baled in hay presses, and sold to nurserymen for packing purposes. This material is remarkable for its ability to retain moisture and is extensively used in the shipment of plants.

Large quantities of holly, mistletoe, cedar, etc., are sold in the cities. Many thousands of the most beautiful and symmetrical young conifers are sacrificed annually for Christmas trees. If the trees were raised for this purpose it would be a legitimate business, but the Christmas-tree gatherer, in order to secure extra fine specimens, cuts the tops out of large-sized red-cedar trees, just as fishermen peel the inner bark from the butts of the white-cedar for fish-strings.

Many flowers, especially those of *Magnolia glauca*, are collected in large quantities and sold.

The cultivation of the willow for basket work is in its infancy in New Jersey. The wood of the white-oak (*Q. alba*), when split into thin slivers, is an excellent basket material.† These baskets are strong and durable. The common American market-basket is not woven. It is extremely cheap and simple, and goes with the contents.

There are many plants of more or less value medicinally. Perhaps the most important, which is common throughout the

* The persimmon grows luxuriantly in the old fields of South Jersey, where animals have carried the seeds. It is possible to bud or graft these trees with choice varieties of the persimmon, which produce, when in the proper stage of ripeness, a very delicious and salable fruit.

† The basket-tree of the South, however, is *Quercus michauxii*, the basket or swamp-white-oak. This tree is very closely related to *Quercus platanoides*, if not a southern form of the same. It grows in the swamps of South Jersey, but is not abundant. It is one of the most magnificent trees of the oak family. A few years ago it was plentiful on rich southern swamp bottoms. Its wood is of very fine quality for constructive purposes, and possesses a peculiarity which especially fits it for basketry. Each annual ring may be easily separated in the form of a thin flexible strip of great pliability and strength. The thousands of baskets used in the cotton fields of the South were woven from ribbons of this wood. This, together with the facts that it requires rich land, and does not reproduce itself freely, is about to cause its extermination.

woods of the E. Carolinian Zone, but rare in New Jersey, is the witch-hazel (*Hamamelis virginiana*), a fluid extract of the twigs, etc., of this plant is a famous lotion for allaying inflammations. It is used by everybody for the ills of both man and beast. It is a peculiar shrub, with several branching crooked trunks, about ten feet in height. Its pale yellow flowers bloom late in autumn when the leaves are falling, and the woody capsule, which explodes and scatters its two black shining seeds, matures the following summer. It grows well on the poorest kind of gravelly soil.

Acorns are abundant and are fed to swine. There is a fair crop almost every year, and an immense crop every now and then. Turkeys which thrive on dry, sandy soil, feed on the acorns. Black walnuts contain rich food material and are used by confectioners. Hazel-nuts grow well in the swamps, having escaped in several places from cultivation. The wild chestnut thrives in the moist sand of South Jersey, and although the nuts are usually small, they are very sweet and abundant. In addition, the collection and careful preparation of the seeds of important forest trees would yield ever-increasing returns.

I have yet to mention forest litter, especially the collection of "pine-chats" * or leaves, which in many pine regions plays a very important and peculiar role.

Forest litter is extensively collected in southern New Jersey for the bedding of animals and as fertilizer for sweet potatoes; † in fact, fair crops of this staple food material may be raised on extremely sandy soil, without other manure.

It is, however, south of New Jersey, on the peninsula between the Chesapeake and Delaware, where the litter is most assiduously collected and used. The conditions which exist there are peculiar and instructive to those interested in the amelioration of pine-lands. In fact, it is the demand for forest litter which in a great measure has prevented forest fires and impressed upon the natives the value of their forests.

* In provincial English the term "chat" means catkin, or a twig for kindling. The term "catkin" means little cat. There may be some connection between the old English application of the term to small twigs and the use of the word pine-chat in the South.

† The German literature on this subject is quite exhaustive. The manurial value of pine straw lies mainly in its nitrogen contents. From one acre there may be had annually about 2,500 pounds of straw, furnishing about 20 pounds of nitrogen, 12 pounds lime, $3\frac{1}{2}$ pounds potash, $3\frac{1}{4}$ pounds magnesia and less than 3 pounds phosphoric acid.

Almost every farm has its pine forest. These, of course, are of all sizes and ages, varying from fields as thick and dense as grain to forests fit for large-size timber. There are few signs of forest fires.

The soil is light and sandy, dune-like in nature, along the shore, to which the pines grow close, although a few have been killed here and there by shifting sand. The natives recognize the value of the forest in holding the soil in place, and in protecting their truck-patches from the force of the wind, which would naturally at times sweep over this narrow peninsula.

On entering one of these forests, one observes at once that although there are many small trees of holly, and bushes of sweet-gale, the ground is free from litter and brush. If one happens to visit the region at the proper season he will see men and women raking up the forest litter. Very early in the spring or late in winter one can see field after field covered with pine-chats, to be plowed under just as soon as the weather permits. In fact, the fields are laid out in squares, by means of the plow, in order that the pine-chats may be easily measured and thus evenly distributed. Just as soon as a field becomes worn out it is abandoned; the adjoining woods furnish the seed, the wind sows it, and soon a fresh growth of pines appears. Here and there throughout the forests there are avenues, which, although constructed to facilitate the collection of pine-chats, serve at the same time the purpose of fire-lanes.

Because of the value of the pine-chats the forest floor is free from inflammable materials just at a time when fires are most likely to occur. The removal of this debris is contrary to the principles of German forest management, because it naturally impoverishes the forest soil. In the course of time, however, many of these potato-fields are allowed to come up in pines, and fresh fields are cleared when the pines have been cut.*

* Unlike other crops, the forest constantly improves the soil, provided the litter is not removed or allowed to burn. The roots of trees penetrate to its deeper layers, and absorb large quantities of mineral matters. A large percentage of this material goes to the leaves, and is deposited on the surface. The surface soil is both enriched by these mineral substances and protected by a mulch of humus in varying stages of decomposition. As the lower layers rot, new layers of leaves and twigs are being constantly deposited, so that the forest soil, in the course of time, fairly reeks with nourishing plant-food. It has been shown, without doubt, that the removal of litter from poor soils is ruinous. It is like stealing food from a starving man. The removal of forest litter from rich soils is indeed, however, a very small matter, and it is doubtful if it really does very serious injury.

Another point of great advantage is, that the forest is not continuous, but cut into parcels, with farm lands and glades inter-vening. In fact it is a land of thrifty forests without foresters, and practically without the need of forest laws.

For private holdings of pine lands, I am inclined to favor this method of management, under the peculiar conditions existing in certain parts of America. In this way the forest constantly yields, indirectly, an important income. It is simply a rotation of crops, of which the pine is the most important, producing throughout its whole life a material which, to the farmer of the eastern shore of Virginia, is of more value than wood.*

It is easily seen, from the condition of the forest industries which have just been described, that the Coastal Plain of New Jersey has passed through the first and most lucrative stage of its existence. The time is at hand for the establishment of industries with permanency in view. The most important step in the right direction would be the protection of its woodlands, game, fish, oysters and clams, which were once so abundant.

* By this system of culture the pine naturally and quickly regenerates. Large quantities of swine run in the forest in this region, and probably do as much good as damage in keeping the soil loose on the surface and by covering the seeds in the process of rooting.



II. Forest Policy and Silvicultural Suggestions.

FOREST POLICY.

As has been explained already, there exists in Southern New Jersey a vast area of land which is in a deplorably unproductive state. It is sufficient to say that in the hands of private owners, under the circumstances which at present exist, the future of a large part of this land is not bright. A change of some kind is necessary, and this must come either in the form of a change of ownership or of the circumstances which fetter ownership.

The only way in which the ownership may be quickly and materially changed would be by State purchase. It is questionable whether under the circumstances State ownership would be justifiable, and whether, even if it could be easily accomplished, it would improve the situation. The State ownership of forest land in New Jersey is only justifiable on the ground that the presence of forests is necessary for purposes of protection against the destructive forces of nature, for pleasure parks or for the purpose of preserving the beauty of certain unusually beautiful or wonderful localities, such as the Palisades.

It is generally conceded in this country that State ownership of forest land for revenue is unnecessary. The American people, in fact the Anglo-Saxon race as a whole, has a wholesome aversion to the participation of the State in industries for the purpose of revenue.

Many claim that even in cases where the forest exerts no very marked influence in a protective way against the destructive forces of nature, that the State ownership of forests is justifiable on the grounds that it requires so long for trees to mature that private individuals are unable to grow and handle them satisfactorily to themselves or to their neighbors.

This argument, however, does not always hold good. Were a man to plant the seed and then wait for the forest to mature, even the most ardent forester would become impatient. Were

he to begin, however, with a forest such as exists even in New Jersey, he could, even from the beginning, reap something every year, and his forest would, at the same time, improve in quality and productiveness. It is quite possible for a private individual to sow the seed and reap at least three or even four crops of salable materials in a lifetime. It is worthy of note that some of the finest, that is the most productive, forests of Denmark are under private control. A private forest does not always mean a neglected forest and a short rotation. Many rich families in Europe gladly avail themselves of this sure and permanent way of investing their fortunes, which pass from father to son, as do the date-groves of the East. In America the railroads, express, telegraph and telephone are private. The finest institutions in America are due to private enterprise. Great public reforms are usually brought about by the energy and influence of a few public-spirited people. After all, what is the state in America? It is simply an organized community, the ruling powers of which are only persons which the people have chosen temporarily from their midst. The purchase of forest land, the management of forest land, or the sale of forest land, depends upon what the majority of legislators may think best, and they in turn are supposed to comply with the wishes of the majority of their constituents. The personnel of the legislature is constantly changing, so that the management of forest lands owned by the state would be subject to many vicissitudes unless placed permanently and absolutely under the care of one of our best educational institutions or in the hands of other permanent and reliable trustees. Since, then, the state control of forest lands is not justifiable on the grounds that large timber cannot be raised from the seed in an ordinary lifetime, let us consider briefly the question of protection which it affords in South Jersey against the destructive forces of nature.

The effect of the forest on the climate of South Jersey, except in so far as it breaks the force of the wind, is probably slight. Owing to its insular position the effect on the precipitation of moisture is probably not considerable. The effect of the forest in these respects is in general disputed and not proven. The effects of the forest on the run-off of water is also of small moment because the country is so flat and the soil is so porous that floods never have and probably never will occur.

The great function of the forest on the sandy soils of Southern New Jersey is the beneficial influence which it exerts on the quality of the soil, both physically and chemically. The forest fixes the soil, preventing it from shifting. The winds would blow it from place to place were it absolutely bare. The forest brings from the subsoils inorganic materials which it deposits on the surface in the leaves and wood. The soil is enriched and protected from the beating and leaching force of the rain and the drying effects of both sun and wind. The granules of silica are gradually comminuted by the chemical action of decomposing organic matter so that the influence of the forest on a coarse, sandy soil tends to render it more and more of the nature of loam, and finally, in the course of ages, fertile and able to support not only a dense forest growth, such as Fontainbleau, but even in time fit it for agricultural purposes. In fact, this is the only rational form of treatment for such soils, and although they may become fit for agricultural purposes in the course of time, the forest should be one of a series of crops. In this system of rotation the interval from the time the forest is cut until the land is allowed to come again in forest should be short.

In rocky regions the soil is constantly fed by disintegrating stones on the surface and in time recuperates, but with sandy soil the only natural fertilization is by means of the forest, which returns, in part at least, the materials which have leached into the deeper layers of the soil while the land was under cultivation.

Since, then, considering all things, the State is not justified in purchasing and managing these pine lands, and since it is extremely doubtful whether their condition would be materially changed by State ownership, it is important to consider the circumstances which fetter private ownership. It is safe to assume, without further discussion, that the woods of South Jersey, for a long time to come at least, are destined to remain in the hands of private parties. They must be regarded, therefore, as *business* and not *protective* forests, although they may of course perform both functions at the same time. The possibilities of successful forest management from a business standpoint are dependent upon certain fundamental conditions. These forests must be regarded in the light of *supply forests* for

materials needed for local consumption and for export to neighboring cities. We must consider, therefore, the following conditions :

- (1) The ability of the State to afford protection to private property.
- (2) The geographic position of the region in reference to markets and in reference to means of transportation.
- (3) The value of land and the cost of labor.
- (4) The quantity and quality of the materials the region is capable of producing.
- (5) The ability to use the materials in local industries.
- (6) Fair taxation.

Let us consider, first, fire :

This is the kernel of the whole question. Although no end of legislation has been passed on the subject, nothing has been accomplished. Not to mention forest management, the State has failed up to the present time to protect the property of its citizens. Until this is accomplished but little progress is possible.

The "fire season" in New Jersey begins about the middle of March, and continues with more or less fierceness until the end of October. Sometimes only the thin leaf-covering of the soil is burnt, and little damage is done ; sometimes the deep, dry muck of the swamps burns for many days, and sometimes the fire sweeps through the crowns, but often the surface, crown and ground fires are one, roaring and rushing irresistibly with the wind, with miles of front, until stopped by a lack of food material, a fall of rain or a stream of considerable dimensions.

About fifty per cent. of the fires of the Coastal Plain of New Jersey are caused by sparks from locomotives, ten per cent. are set by incendiaries for evil purposes, ten per cent. are set purposely to improve the berry crop or pasturage, and the rest are accidentally and carelessly set.

The effects of fire are practically the same all over the world : impoverishment of soil, destruction of game and its food supply, unhealthfulness, increase of insect pests, in addition to the loss of wood and other property and injuries to industries which use wood.

For the prevention of fire, the punishment of fire-setters and the construction of wide fire-lanes along all public wagon-roads

and railroads, are necessary. Railroad companies should be required to construct lanes, broad and clean enough along their tracks, to eliminate all danger from flying sparks, to ditch all swamp-lands to water or sand on the outer edge of the lane, and to constantly use efficient spark-arresters on their engines. The townships should be required to construct similar lanes along all public roads. In this way, what are now points of danger, from which the majority of fires start, would become avenues for the prevention of its spread, and would serve at the same time as vantage points in combatting it. Whenever possible these fire-lanes should be kept under cultivation, in other places the brush * should be cut, and all combustible materials burned at a time when there is no danger of setting fire to the adjoining woods. The usual method of extinguishing extensive fires is by "back-firing" or "counter-firing." This is, however, dangerous work, and should not be attempted save by those who are experienced and capable. Very often the back-fires, set by inexperienced, excited persons, have not only resulted in disastrous conflagrations, but have rendered the skillful work of others of no avail. For the extinguishment of surface-fires, shovels, sand and hard work are usually sufficient. Fortunately, sand is everywhere plentiful, except in swamps. It is often possible to beat out surface-fires with a green bough or bush. In the extinguishment of ground-fires, or those which burn in the peat of swamps, it is necessary to confine them within certain limits by digging deep trenches.

Formerly charcoal burners set fire to the forest in order to be able to purchase it cheaply, by rendering it unfit for any other purpose than coal wood. The charcoal industry is done, but the natives still fire the huckleberry-bush to produce fresh shoots on which the finer berries grow. Berry-picking is an important industry, and the occurrence of such fires is common. The main differences between the conditions existing in Southern New Jersey and the peninsula between the Chesapeake and the Dela-

* The "Esterel," a region of France not far from Cannes, is famous for the elaborate fire measures which are in force there. It is a mountainous district, thinly covered with pine and cork-oak and extremely susceptible to fire, which causes great havoc when the very violent wind, called mistral, blows. I visited it a few years ago and was surprised to find that, in addition to the formation of many fire-lanes, the removal of underbrush, observation posts, telephone, perfectly organized patrols, etc., that they burn over patches of the surface every year from December to February with the object of preventing the growth of weeds and underbrush and the accumulation of combustible litter. Little by little the whole area is burned over in this way.

ware are, that the forest-land there is cut into many small blocks, between which is farm-land, and that the proper sentiment exists in the minds of the natives, a sentiment due to the value of the pine-chats.

The division of large tracts of land into parcels is of advantage economically and socially, provided they are of a size sufficient to support a family of ordinary intelligence. Such a farm should consist of at least thirty-five acres of cleared land and sixty-five acres of woodland. The sale of city lots in the woods, or even five or ten-acre plots, is rarely fruitful of good, and is, on the whole, detrimental in the end to the purchaser and community in general.

Where fire constantly burns the litter from the surface and prevents the formation of young forests, the soil constantly deteriorates and finally becomes sterile and lifeless—literally lifeless—because the organisms in the soil which cause the decomposition of humus and the conservation of nitrogen are killed. The prevention of fire, therefore, is of course the first and most important step.

Further discussion in reference to the prevention of fire on lands owned by private parties seems like threshing old straw, but since it is hardly likely under the circumstances that the State would buy and properly care for this vast tract of sandy land, or would force private parties to institute efficient measures in this line, as is common in Europe, it is necessary to devise other schemes which might accomplish this end and which fit the peculiar conditions, political, social and economical, which exist.

It is generally recognized throughout Europe that the construction of suitable fire-lanes throughout the forest conduces more to the prevention of great conflagrations than any other institution. The recent fires in the Landes of France were due, it is claimed, to the neglect of fire-lanes. These serve as vantage points in the fighting of fire, and often in themselves are sufficient to prevent its spread. By means of fire-lanes the country is cut into parcels and the danger of great conflagrations very materially reduced. These fire-lanes, in order to be efficient, must be wide, clean and well cared for, for otherwise they are of little use. Now the great question is, how to estab-

lish a complete system of fire-lanes for those regions of Southern New Jersey which, from the sandy nature of their soils, are destined for many years to come to remain in forest.

The scheme which I have to suggest is that these fire-lanes be constructed and kept in order in a way similar to the construction of State roads, which have been so popular of late. In this way no terrible burden of expense rests upon anybody. The individual benefited thereby pays part, the community pays another part and the State pays the other part. Woodland owners who would be benefited thereby would not hesitate to donate land for the purpose, while the small quantity of land required of those who may be foolish enough to object should be summarily condemned and appropriated by the State. One would expect very slight opposition to a system of fire-lanes from those persons whom the protection it affords benefits, except perhaps from those who call themselves "land-poor," that is, persons who own so much unproductive land that they cannot pay their taxes.* Such people would not object to the relinquishment of small strips of unproductive land, but would hesitate with the fear that it might increase their burden of taxation. But the difficulties of this kind would be no greater than those which have been met and overcome in the construction of roads. As with all progressive movements of this kind the opposition fades away and the strongest opponents are often the loudest of praisers in the end.

The owner of the land would be benefited and encouraged and the payment of a slight increase in tax would be a great and permanent investment. Lands which are now a burden to him would become more valuable and the capital which is buried therein would increase and, if need be, become available. The money which the county and State would expend would return a hundred fold in increased resources and prosperity, and would benefit those who are most in need of it.

The State or county or township ownership, or combined ownership, of a system of fire-lanes, in no way savors of paternalism, and should be as palatable to the American taste as the

* Fire-lanes may be constructed at slight expense in Southern New Jersey. After the wood is cut it is necessary to plough three or four furrows along the edges and then to burn over the lane at times when there is no danger of setting fire to the neighboring woods. A lane fifty feet in width would be quite efficient.

State ownership of roads. In fact these lanes may serve at any time as roads, or may be converted into such on short notice at almost any time. Fortunately gravel is almost always near at hand, so that in the course of time the whole fire-lane system may be converted into a great road system, which would add much to the value of the land and increase the value of the wood, owing to the ease with which it could be transported. After visiting most of the forests on sandy soil in Europe, and having lived a number of years in the pine-lands of South Jersey, I am convinced that it is foolish to talk of forest culture and silvicultural methods until fires are reduced in number. For this purpose fire-lanes are essential, and this is the only scheme I know of which seems practical and possible. Once institute a perfect system of fire-lanes under combined State and local control and the number and severity of the fires will be reduced to such an extent that the evil will, I am certain, gradually fade away, and modern systems of silviculture will gradually creep in as the value of wood and land increases. The people of the State are perfectly familiar with the *modus operandi* of the road law, and the same general principles applied to fire-lanes would be no great and startling innovation, but would, I am certain, be fraught with beneficial results. It is the only system which appears to be perfectly adapted to the peculiar conditions which exist in Southern New Jersey.

Such an institution would have also a great educational effect. Many people who had never thought of such things before would be impressed by the object-lesson. The constant presence of such reminders would impress upon certain classes of people the facts that fires are not necessary, that the useless destruction of wood is wasteful, and that the absence of wood in a country which is fitted only for its production means a lack of work for woodsmen, teams and sawmills.

In addition to these fire-lanes let all the existing roads of the southern part of the State become a part of this system by being converted into fire-lanes, that is, widened and cleared of combustible materials along their edges. The remotest portions of these vast piney-lands will in this way become accessible, and the large amount which is actually invested in woodland and cranberry-bogs will be rendered safer, with surer yields. A

large amount of money which is lost in fire-fighting will be saved.

Just as there was opposition in the beginning to the new road law, so there will be opposition to such a scheme; but let the State inaugurate it in a trial district and soon others will follow. It will not, of course, stop all forest fires, but it will certainly reduce their size, stop their fury and save the loss of much valuable material. The new State road from Atlantic City to Camden is a fair sample of what is needed. It serves at the same time the purpose of fire-lane and thoroughfare. Formerly it was a bed of hot, dusty sand. Many new buildings have been constructed along the road, and owing to the ease of communication and transportation it has brought the people along it closer together and has instilled into the old residents a certain amount of life and spirit which they never would otherwise have obtained. If cleared of brush along their sides, many of the gravel roads of South Jersey, which are often now the points from which fires start, would serve as fire-lanes in preventing the spread of fire and as vantage grounds in combatting it. The local officials who have charge of these roads and lanes could, if required, extinguish many fires in their incipient stages.

The consideration of these fire-lanes as future roads leads to the second important condition—markets and transportation.

This question needs but little consideration. A glance at the map is sufficient to convince anyone that no region could be more auspiciously located in this respect. With plenty of good gravel with which to construct roads, with many railroads, with many navigable rivers and with two of the largest cities of this country near at hand, but little more in this respect could be desired. At the same time, however, we must not fail to consider the fact that other great wood-producing regions are near at hand and that in Pennsylvania there are immense quantities of coal. This state of affairs naturally suggests that the production of wood for fuel, as is now generally the case, is the least profitable of the forest industries which may be practised in South Jersey.

The third condition relates to land and labor. This question also needs little consideration. There are thousands of acres which may be had at a ridiculously low figure, considering the

location, and everyone familiar with the region knows that there are hundreds of woodsmen who are stagnating and degenerating in consequence of a lack of work.

The fourth condition relates to the quantity and quality of the materials the region is capable of producing, and since I shall refer to this later under the head of *Silvicultural Suggestions*, it is sufficient to say in this connection that owing to its peculiar soil and climate South Jersey has and is still able to produce just those kinds of forest produce which are most in demand.

The fifth condition relates to the possibility of the establishment of local industries which may consume the products of the forest or which may convert these products into less bulky and more salable form.

When certain industries may be established within a region it is, of course, a great advantage in many ways. It increases the working population, the value of property and improves the standard of life. Labor is at the base of pleasure and intellectual development.

At present large quantities of wood are supplied to glass and brick factories throughout South Jersey. The fuel question, however, is of little importance, and will always take care of itself in this country. In fact, even the woodsman, when he can afford it, will burn coal because of its convenience.

The first industry which would flourish on the production of saw-stuff would be the saw-mill. And if only the increment is cut, as should always be the case, many small mills, instead of a few large ones, would result. The condition might be similar to that of parts of Germany where many small mills are constantly at work year after year cutting the well-earned increment. The big mill with its elaborate, costly equipment, working with feverish excitement half the time and idle the rest, did not develop however in this country until after the timber resources of South Jersey were practically exhausted. Even in the great lumber districts the large mill, when our lumber resources have been exhausted to such an extent that these voracious monsters cannot be fed, will be replaced by smaller establishments which will for some time to come operate on the leavings and the young timber as rapidly as it becomes merchantable. The time is not far distant when the great lumber

industry which has shot across this country with meteoric fierceness will have spent its power. It has been digging its own grave. In the meantime the tide of feeling in reference to the establishment of more rational methods of forest treatment has been steadily rising. This country, although so large, is so closely knitted together by a network of railroads, which favor the distant parts by special long-distance freight rates, that a stringency of even so important and bulky an article as lumber will not be seriously felt until the crop is exhausted, even in the remotest corners of this land, if not this continent. There is nothing surprising in the fact that a man in New Jersey may use in the construction of his house white-pine from the far North, cypress and yellow-pine from the far South and red-wood shingles from the far West, and buy it all from the stock of one lumber dealer in Philadelphia or New York.

Besides the development of the saw-mill industry in Southern Jersey, when the woods are properly protected and managed there will arise, no doubt, many other industries, such as box, stave and market-basket manufacture.

It is, of course, impossible to predict the many industries which may be operated in a country where such a useful material as even the poorest grade of wood is produced.

In the Spessart, in Germany, for instance, years ago immense quantities of beech were planted, to supply the glass factories with fuel. The glass works have ceased to exist and the beech is subjected to a process of dry distillation which yields several valuable products. Hardwoods, by this process, will yield charcoal, pyroligneous acid, an inflammable gas which may be used for illuminating purposes, besides other products. Some day we may export charcoal to the tropical regions of the globe, where it is the most satisfactory fuel because it emits no smoke, and braziers can be used instead of stoves.

Then there is the possibility of producing wood for pulp and cellulose. Spruce is the principal source of supply at present, but even if spruce cannot be produced successfully in South Jersey, which is, however, a question, there are other trees which are and no doubt many which may be used for that purpose. In fact it would be impossible to predict the future of this industry, which, although in its infancy, is already immense.

It is safe to assume that in case the forests of South Jersey are protected and allowed to grow other industries will form and grow with them.

The sixth condition is fair taxation. All are agreed that this is a knotty question and one difficult even under favorable circumstances to fairly adjust. It seems to me that since forests require considerable time to grow, since owing to the force of the elements and disease the growth of years is liable to be suddenly spoiled and shattered, since forests are not insurable, and since the man who produces a forest is the benefactor of his neighbors, the State can well afford to tax lightly such land.* In fact, the man who starts and properly cares for a forest deserves to be exempted from taxation, or at least exempted until the crop is cut. Several have suggested that the tax should be levied only on the amount cut. This plan, of course, has some disadvantages, and may not be practical. At any rate a fair re-adjustment would tend to improve the condition which exists. I have faith enough in the good sense of the American people to believe that with proper protection by the State against fire and thieves, with fair taxation, with sufficient roads and with proper guidance, there will develop even under private control a system of forestry which, although perhaps not as systematically regulated as in Europe, will be as good as the peculiar economic conditions of the region will warrant.

SILVICULTURAL SUGGESTIONS.

It seems to the writer that, notwithstanding the complexities of European silvicultural systems with their manifold modifications and combinations, the methods of forest treatment may be divided into four systems which are more or less applicable the world over, none of which are unconditionally good or bad, and the merits of which depend upon the circumstances of each case. Each system has its advantages and disadvantages, and must be adapted to the conditions which exist in every instance, and its success, above all, is dependent upon the knowledge and

* An anomalous condition sometimes exists where a speculator desires a high assessment and correspondingly high tax in order to convince prospective buyers of the great worth of the land which he is endeavoring to sell.

skill of the person who endeavors to apply it. These systems are, briefly, as follows :

I. The selection system, which is especially adapted to uneven-aged or irregular protection forests.

II. The system of clear cutting and then regenerating by planting with young trees or by sowing the seed, or by waiting until the wind sows it from an adjoining forest.

III. The system of regenerating pure even-aged forests naturally by uniformly and gradually thinning throughout, and admitting the light so that the seeds will germinate and the young growth properly develop.*

IV. The coppice system, where the forest consists of species which will sprout from the stump or the root.

There will probably be opportunity for the application of all of these systems in Southern Jersey. The following is a brief way of classifying these systems :

Selective-cutting system, applicable to pure or mixed forests of uneven age.	{ Regeneration effected irregularly throughout the forest by the removal of single trees or small groups of trees.
Clear-cutting system, applicable to pure or mixed forests of even or uneven age.	{ Regeneration by means of planting young plants or cuttings or by sowing by hand or by natural sowing from adjoining woods
Successive-cutting system, applicable to pure woods of even age	{ Regeneration effected uniformly throughout the forest by successive thinnings and final complete removal of mother trees.
Coppice system.	{ Regeneration effected by stump-shoots and root suckers.

If a party possesses woodland, even if sparsely stocked with inferior kinds, and cannot afford or may not desire to plant afresh with better species, but wishes to gradually improve it, the best system to apply is the selection method.† There are many large forest-owners in South Jersey who are able to employ a forester but who cannot afford the cost of extensive plantings. These

*As early as 1736 this system had developed so far in Germany that three distinct cuttings were prescribed : First, when the seed had fallen and germinated ; second, when the young trees reached the height of a man's knees, and third, the mother trees were completely removed when the young trees had reached the height of a man.

† Irregular forests to which this system is applied naturally suffer more from fire than regular forests.

large land-holders employ managers who are practical men but with little knowledge of forestry. The selection method is usually the best for a new country where the demands for wood are less than the supply, and where a system to be popular must yield enough constantly to pay all expenses, taxes, and a little besides. It is an excellent system for co-operative associations and corporations which have other objects in view, such as the protection of game or water supply. It is extensively practiced in India, where it is usually known by its French name, "jardinage." It is not confined to new countries, however, and is even the favorite method of many European foresters of treating protection forests.

To apply this system it requires more skill, experience and intelligence than the majority of land-holders or managers possess. It is, however, an elastic system, and in its simplest form is practical for land on which there is any growth worthy of the name of forest.

It is about the reverse of what is ordinarily practiced in America. In New Jersey one man may buy all the merchantable oak on a certain piece of land, another all the cedar, etc. Any diseased trees or kinds without value are left standing, not for soil protection, but because they are not worth cutting. These are stimulated by the increase of space and light, produce large quantities of seed, and soon have complete possession of the soil. In other instances the land is bought with all that covers it and stripped of what is merchantable. Covered with slashings,* it is left to be swept by fire or abandoned to the weeds,† or is sold to land-agents who divide it into many small

*The first steps toward forestry in Germany were the removal of slash and the leaving of seed-trees here and there of a desirable species.

†A weed is simply a plant out of place. Trees, under certain circumstances, may be weeds. In fact, the common custom of culling the best from the forest is similar in effect to harvesting the vegetables and fruits of a garden without disturbing the weeds.

In the swamps of South Jersey, clambering vines and worthless briars and bushes often have complete possession of the soil. The various species of grape which mingle with the branches of trees hinder, of course, their growth, but, owing to their beauty and the value of their fruit, their presence is not so odious. It is quite otherwise with the poison ivy (*Rhus toxicodendron*) which firmly clasps the roots, trunks and branches of trees, and is poisonous to the touch. The swamp sumac (*Rhus venenata*), which is a shrub, and often almost a tree, is abundant, and is also poisonous, causing a distressing dermatitis, which is often accompanied by serious illness. Another class of extremely disagreeable weeds are the climbing, prickly briars of the genus *Smilax*. The most provoking feature of these weeds is that when their rhizomes have once gained possession of the soil, it is well-nigh impossible to eradicate them. Clothing and skin are torn in handling them, burning only causes them to sprout with fresh vigor, and, if left alone, they soon reach the tops of trees, to which they become inextricably attached. The only way to get rid of them is to cut them down with a bush-hook or machete, and then with a grub-hoe dig up their rhizomes, bit by bit and year after year, until their extermination is complete.

farms, which they sell to all sorts of new-comers. Sometimes it falls into the hands of speculators, who hold it indefinitely, with various purposes in view. In consequence of this mode of treatment, uplands which once produced pine fit for ship timbers are now only bush-lands; swamp-lands which have yielded choice white-cedar are now cripples. The only suggestion of silviculture is the custom of leaving a seed-tree here and there. Many of these seed-trees were left, however, not for the purpose of seeding the ground, but as line-trees, to mark the borders of properties.

The aim of the selection method is the constant betterment of soil and forest. It prescribes that the soil must be kept covered, and that the most valuable species must always be encouraged. The dead and diseased trees must be removed, also all inferior kinds which are a hindrance to a young, more promising growth. Many minor points the owner or person in charge must settle. The axe must be cautiously used, and always with a purpose beyond the immediate reaping of a wood crop, and the operator must be perfectly familiar with the peculiarities of the species with which he is dealing. Caution in cutting, and the sowing of seed, or the planting here and there of desirable kinds, will, in the course of time, bring order out of chaos.

On large areas of Southern New Jersey where there is little more than bushes it will be necessary to plant afresh. In many instances where the forest is very thin and of poor species it will pay in the end to cut clean and establish a new forest by either planting or sowing. The system of clean cutting and planting has many advantages and disadvantages. One can work in a systematic and regular manner and can start the kind of forest he prefers. It is, however, usually expensive, the young plants are in greater danger of frost, drought, weeds and disease, and the fertility of the soil is impaired by being bared to the action of the elements for a considerable period of time.

If one has a pure, even-aged forest, the third system is probably the best. This is the system which is so successfully applied to the spruce forests of Europe, and is an excellent way of regenerating white-pine in this country, and also, perhaps, white-cedar in South Jersey. In this system regeneration occurs uniformly over the whole area under treatment. When the trees

have reached maturity regeneration is effected by a series of uniform successive thinnings. The number of thinnings depends upon the circumstances of the case. Success in the method depends primarily upon two conditions: First, the trees must be in condition to produce a good crop of seeds; and, second, the forest floor must be a favorable bed for germination. From that time on the forest must be gradually thinned and finally removed as rapidly as the condition of the young growth will permit, which varies with the species, climate, soil, etc.

This system is only applicable to pure, even-aged forests. This is a disadvantage, however, because for several reasons the tendency at present is decidedly in favor of mixed growths. Pure growths, especially of conifers, are much more seriously injured by the destructive forces of nature, such as winds and insects, than mixed forests. An excellent form of forest from a silvicultural standpoint consists of a growth of conifers with an underwood of some kind of shade-enduring deciduous trees. The overwood is healthier and the soil is protected and enriched by the underwood. To produce this kind of wood it is necessary usually to resort to the clean-cutting system with regeneration by planting or sowing.

The fourth system, coppice, is so simple that little explanation is necessary. The crop is simply cut clean year after year, and the new crop is formed either from stump-shoots or root-suckers. Care should always be exercised in cutting the stump close to the ground, with a clean sloping top, so that there will not be the slightest opportunity for rot and so that the young shoots will be healthy and sound.

In the choice of species for planting and for favoring in mixed growth we should not fail always to consider the silvicultural qualities as well as usefulness for lumber. Fashion often guides us in our choice of kinds, and we should not fail to bear in mind that modern devices of treating wood may completely change its appearance and durability.

The species of trees which may be successfully grown in southern New Jersey I have divided into two groups—first, those which require good soils, and, second, those which will thrive on the poor sandy soils and swamp-lands of the Coastal Plain; and since the latter are the lands to which the forest will

in time be relegated, I shall describe here mainly those species of the second class.

To the first class belong such trees as the white-pine, the white-oak, the swamp-white-oak (*Quercus platanooides*), the beech, the chestnut (*Castanea dentata*),* the black-walnut, the shagbark-hickory, the tulip tree, the white-ash, the sugar-maple, the basswood, the Douglas-spruce (*Pseudotsuga taxifolia*), and the Norway-spruce (*Picea excelsa*). To the second class belong such as the following: the short-leaf-pine (*Pinus echinata*), the red-cedar (*Juniperus virginiana*), the white-cedar (*Chamaecyparis thyoides*), the locust (*Robinia pseudacacia*), the cottonwood (*Populus deltoides*), etc.

Others which may be classed as subsidiary sorts, and which, under certain circumstances, are worthy of encouragement, are chestnut-oak (*Quercus prinus*), sassafras, holly (*Ilex opaca*), bilsted (*Liquidamber styraciflua*), brewster (*Magnolia glauca*), red-maple (*Acer rubrum*), and wild-cherry (*Prunus serotina*).

Pinus echinata, formerly *P. mitis*, is the most important pine of Southern New Jersey. It is usually associated with the pitch-pine (*Pinus rigida*), with here and there patches of the scrub-pine (*Pinus virginiana* or *inops*).

Several foresters have encouraged the planting of pitch-pine in New Jersey, because it grows on extremely poor soil, and endures a great deal of fire. This tree is not the equal of *Pinus virginiana* and inferior in almost every respect to *Pinus echinata*. It is a mistake to encourage the propagation of inferior species, such as the pitch-pine, in regions where *P. echinata* and several other excellent trees grow equally as well. Pitch-pines are, of course, better than nothing, but when they are mixed with *P. echinata*, as is often the case in Southern New Jersey, the latter should be favored. In spite of fires, and the great demand for its wood in early times for ship construction, owing to its marvelous reproductive ability, the smooth-bark-pine has held its own.

*In a way, the chestnut is without a rival. It is a rapid grower, forming a vigorous coppice, producing a valuable nut, and yielding a wood which is highly prized for fuel, fence-posts, fence-rails, ties, telegraph poles and interior house-finish. For the latter purpose it has become of late very fashionable and is equal in beauty to other hard woods which are worked with much more difficulty. The chestnut should be grown wherever the soil is able to support it. Like the black-walnut the chestnut is able to grow on soils which may be classed as medium in quality, and (in places where there is sufficient moisture) even on very sandy soil.

In the "Timber Pines of the South," Dr. Chas. Mohr, in the chapter on this species, says: "When maintenance of forest, and production of timber under a rational system of forestry is to become the rule, this species, above all others of southerly distribution, will claim attention, for it can be safely asserted that of the coniferous trees adapted to the climatic conditions of the Southern Atlantic forest, no other can be found of better promise, for the production of valuable timber in the shortest time." In another place he says: "Among the coniferous trees of Eastern North America, the short-leaf-pine stands next to the long-leaf-pine (*P. palustris*), in importance to the lumber industry and in the value of its timber. Freer from resinous matter, softer, more easily worked, not less susceptible of a good finish, the lumber of the short-leaf-pine is often preferred by the cabinet-maker and the house-carpenter to that of the long-leaf-pine. Less tenacious and of less power of resistance under strain, it is principally used for the lighter frame-work in buildings, for weather-boarding, flooring, ceiling, wainscoting, cases for windows and doors, for frames and sashes of all kinds, and for shingles. Most of the dwellings located within the districts where this tree prevails are built almost entirely of short-leaf-pine lumber, which bears ample testimony to its wide usefulness. It is also extensively employed in car-building, for cross-ties, and in the manufacture of furniture." In another place he says: "No other timber tree found in the southern portion of the Atlantic forest region is more easy of natural reproduction than this, throughout the wide range of its distribution. This is readily accounted for by its great fecundity, the seeds produced in great abundance almost without failure every year being profusely spread far and wide, and germinating easily whenever the proper soil and a chance are offered for their reception. By their thrifty growth the seedlings soon gain the upper-hand over the contemporary growth of other species."

Sudworth, in a paper on the "Forest Trees of Tennessee," says: "As is well known this pine (*P. echinata*, short-leaf-pine) ranks in commercial importance next to the famous long-leaf. The adaptation of the pine to the poor, dry hills and other sloping lands of East Tennessee is truly remarkable as seen in some localities. Theories that great care and nursing are necessary

to re-establish a pine forest on entirely denuded land are easily controverted by the thousands of young short-leaf-pines taking possession readily, and in dense stands of old pasture and abandoned hills, and entirely without the nursing influence of broad-leafed kinds. Even under the damaging influence of tramping stock and invading fire, this young growth has gradually advanced, and solid phalanxes of saplings and middle-sized polewood now form a large part of the second-growth woodlands attached to farms, together with oaks and other hardwoods. There appears, therefore, to be no more useful and valuable concomitant in the future forestry of East Tennessee than this willingly self-propagated short-leaf-pine."

Now and then a beautiful seedling forest, naturally regenerated from adjoining woods, may be seen in New Jersey, and, as in the eastern peninsula of Virginia, if this species is favored, in the course of time it will be the rule and not the exception. It is not difficult, however, to secure a good stand by sowing the seed, provided the seed is fresh and fertile. The easiest and cheapest way is to plant the seed mixed with dirt in rows, or in narrow strips, across the field, four or five feet apart.* The best way to prepare this seed-bed, in case the land is not too stumpy, is to run a narrow, one-horse scratch-harrow over it, and then, after the seed is sown, run the harrow over the same strip again, in order to cover the seed. If one man strikes out the strips with the harrow, while another sows the seed, a large area can be covered in a short time. Where a horse and harrow cannot be used, it is best to work in the seed with a rake. Throughout the south swine prepare this seed-bed. After the seed has been sown, if the soil is very dry and sandy and liable to shift, the strips must be covered with pine-chats and brush, on which a little sand may be thrown to hold them down. As soon as the young pines form a closed canopy thinning should begin, and continue throughout the whole period of their life, so that the trees may have sufficient space and light and yet free themselves of limbs. The removal of litter and the time of cutting depend entirely upon circumstances. If the owner needs the litter it is proper to remove it; if he wants poles or small pilings there is nothing to hinder him from cutting his forest in the pole-stage.

* A good stand of the short-leaf-pine has been secured by spreading the pine twigs with ripe cones attached over the land

Red-cedar (*Juniperus virginiana*) is an excellent tree for the dry sandy upland. No American tree has a more interesting and instructive ecology.* It ranges from Cape Cod to Vancouver's Island, from Canada to Florida. In the north it inhabits dry, rocky uplands; in the south it grows in swamps, which are often covered with water; in the rich bottom-lands of the Mississippi Valley it is a lofty and noble tree; in the limestone regions of northern Alabama it is almost a bush; and along the shores of New Jersey it is flat-crowned and irregular, but a beautiful tree in spite of shifting sand and salt sea breezes. The quality of the wood also depends upon the region in which it grows. In many places it is of little worth; in others it is excellent in quality, strongly aromatic, rich red in color and famous the world over for pencils. It is one of the commonest trees in Southern New Jersey, quickly producing a highly prized wood on soil the surface of which at least is sterile. Its fruits are devoured by birds which scatter its seeds. When growing alone it is pyramidal in shape, with many branches. Sometimes the twigs and leaves are stiff and prickly; sometimes soft and pendulous. The wood of these knotty trees is extremely beautiful, and the limbs are of use for boat knees, rustic fences, etc. It is also an excellent wind-break, although subject to a fungus disease which infests the apple and quince.†

*The basis of silviculture is ecology or the science of trees in relation to their environment, many of the most important points of which in reference to American species are unknown. Much may be learned of the habits of trees by studying them in regions in which they are not indigenous. More is known of the silvicultural peculiarities of several American trees in Europe than in America. A careful study of the tropical forest will throw light upon many physiological problems, especially those which have to do with climatic conditions (see *Haberlandt's Tropenreise*). It behooves the Americans to emulate the Dutch in Java and the English in India, and establish in their new possessions experiment stations, schools and laboratories where northern students may study plant physiology, the *sine qua non* of agriculture and silviculture.

†The cedar-apple (*Gymnosporangium macrospus*) is common throughout the State, and is of special interest because it leads a dual life, one phase of which is on the red-cedar (*Juniperus virginiana*), and the other has the cultivated quince, apple and their allies for its host plants. On the twigs of the cedar it causes brown, irregularly lobed excrescences, as large as chestnuts, over the surface of which there are slight indentations or centers in which the teleutospores are located. These spores are thick-walled, brown, two-celled bodies, which in warm, moist spring weather, germinate, that is, the cell-wall breaks, and there protrudes from each cell of the teleutospore a hypha or tube on the end of which several small spores or sporidia are formed. All the germinal tubes from one center adhere together, forming an orange-colored, gelatinous, tentacle-like growth. Several of these gelatinous masses, distributed over the surface of the whole excrescence, give it the appearance of a chrysanthemum a short distance from the tree. Very often many hundreds of these may be seen on a single tree, and when they are in the height of their germination are peculiarly striking. The sporidia are borne long distances by the wind to the young, tender leaves of the apple and quince, on which, if the conditions are right, they soon germinate, and produce the other stage of this peculiar disease, which, on its orchard hosts, causes the well-known "rust." Although this fungus does practically no injury to the cedar, "the rust" is a very serious disease, especially in the south. It is more dangerous to quinces than to apples. The spores can be carried by the wind several miles. Although not wise to plant orchards in the neighborhood of red-cedars, or *vice-versa*, this disease is not of sufficient seriousness to discourage the propagation of the red-cedar in South Jersey, because the apple industry is there of little importance.

The young red-cedar trees are difficult to transplant in dry sandy soil, and the seeds, although abundant and easily collected, rarely germinate evenly. I have been told that nurserymen bury them in a "rot-heap" for two winters and a summer, and sow them the following spring. (The same is true of the holly [*Ilex opaca*].) The wood of the cedar, even when knotty, is in demand for posts; the quality produced in Southern New Jersey is excellent and there is little land too dry and sandy to support it.

Of the hardwood trees, the most valuable for the dry uplands of New Jersey is the *Robinia pseudacacia*.* In the Region of Bordeaux, where the soil is similar to that of the Coastal Plain of South Jersey, extensive private plantations may be seen. For this purpose, especially on small farms where fencing is an important item, the locust has no equal in spite of the depredations of the borer. In California, I have been told, the borer does not exist, and that in twenty years a locust tree in the open attains a diameter of as many inches. It is claimed by some that the injury caused by this insect is less if other trees are planted with the locust. It is excellent for planting in open places in the forest in the form of hursts, here and there, or as a fringe to pine plantations especially along railroads because it is not inflammable. The locust grows rapidly on poor soil, produces an extremely useful and durable wood and an ash richer in inorganic constituents than the majority of hardwoods. As

*A great disadvantage of the locust is the fact that it is seriously infested in this country by the locust-borer (*Cyllene robinia*). It was indeed fortunate for Europe that when the locust was introduced this pestiferous insect was not imported with it. In Europe, it is a beautiful shade and ornamental tree; in its native land, owing to the depredations of this insect it is usually unsightly. The trunks and limbs are sometimes completely honeycombed by this insect. If the trees are watched in August and September, one is likely to find handsome brown and yellow banded, wasp-like beetles, laying oval, dull white eggs in wounds and crevices of the bark. In about ten days these eggs hatch and the larvæ bore into the tree. They are still small by winter, during which time they lie dormant in the wood. In the spring they begin to bore, until about August, when they stop feeding and enter the pupa stage, and a week or so later appear as full-sized beetles. These beetles live upon the pollen of the golden-rod. The outermost trees are usually completely riddled, while those in the center of a group may escape altogether. It seems to suffer less also when mixed with other trees. Although these insects are very abundant and seriously injure the wood and impair the vitality of the tree, it is still fit for fence posts, for which it is almost exclusively used. This insect infests healthy trees, growing on rich soil, but the proportion of trees in a plantation which is thus seriously injured is not sufficient to discourage the propagation of this unique and extremely useful tree. Owing to the depredations of the locust-borer it is always best to mix another species with the locust. For this purpose *Prunus serotina* and the American chestnut are excellent. The wild-cherry (*P. serotina*) is worthy of more encouragement than it has heretofore received. It grows on poor soil, is easily propagated, yields an excellent wood, and attracts birds which are fond of its fruits. Mr. J. H. Schober, the pioneer of heath planting in Holland, who is experimenting with many species of foreign trees on his plantation at Schovenhorst, was loud in his praises of this tree and pronounced it one of the most promising of his vast collection.

with other leguminous plants, bacteroids, which reside in a symbiotic state in tubercles on its roots, are able in some mysterious way to accumulate nitrogen. The litter, which is rich but thin, quickly decays. Once established, the locust hurst will never need renewal; hundreds of stool-shoots and root-suckers are present to take the places of felled trees on the admission of light. Besides a tap-root the locust has an extensive horizontal root system by which the soil is held in place. It is for this reason used on railroad embankments and dry soils subject to shifting. The wood is useful for posts and other purposes, even when young, and is therefore of great value for private planting. Both red cedar and black locust may be sown in the same way that I have indicated for the pine. The seeds of the locust, if planted in the spring, should be soaked in warm water for three days before planting.

The white-cedar (*Chamaecyparis thyoides*) is the choicest of the soft woods of Eastern America. Not even inferior to the famous pumpkin-white-pine. In fact, for boat and tank construction it has no equal. The wood is light, soft, clean, easily seasoned, and remarkable for its durability.* It neither warps nor checks under the most trying circumstances. It is extensively used for bridge-plank, shingles, weather-boards, interior finish, and in the construction of fences either in the form of rails or palings. It has a pleasant cedary aroma, and when exposed to the weather becomes a beautiful steel or lichen-gray color.

The white-cedar should be grown in the form of a pure crowded wood, on wet mucky or wet sandy soil. The canopy should be uninterrupted, and the lower limbs should interlace. If the forest is too thin, irregular, with all age classes and here and there other species, the trees are easily uprooted by the wind, owing to the slight hold which they have upon the soft mucky soil. The stand should be so thick and the lower limbs interlace to such an extent that the tree will free itself from branches, produce clean boles and prevent the growth of underbrush. Owing to its sharp, conical top it endures close plant-

*The bark of the white-cedar is tough and fibrous and similar to coir in nature. Many trees of this species in South Jersey have been ruined by the fishermen, who use strips of the tough bark on which to string their fish. In Russia the manufacture of mats, rope, etc., from bark is an important industry, and in New Jersey the white-cedar bark might be used for similar purposes.

ing, although regular thinnings are necessary almost throughout the whole period of its life.

In this way, even in America, the forest will yield a small but constant income, since there is some demand for cedar poles. When sawed in half, barked and soaked in preservatives, these poles, even when very small, are of use in the construction of fences. In spite of the common use of wire, there is still in America great demand for good fence material. These saplings are useful for vine-props, masts for small boats, handles for rakes, boat-hooks and the like, racks for wagons and stalls, flag-poles, plaster-laths, fence-palings, and even shingles. In fact, from the time the tree reaches a diameter of three inches it is useful.

If a cedar tree becomes covered with gray lichens, as is often the case, it indicates slow growth, unhealthfulness and unsuitable environment.

The cedar is a great seed-producer, even when quite young. The seeds are formed in small cones and are easily collected. A pure stand of cedar may be secured in three ways. If one has a mixed deciduous swamp, with here and there a cedar, as is common, the easiest way to convert it into a pure stand of cedar is to cut and keep down all trees except the cedar. These seed-trees, with the admission of light and air, will produce an abundance of seed. A stand of cedar produced in this way may be irregular and uncertain. Perhaps the easiest and quickest way to secure a stand of this tree is to plant it. Young cedars are constantly invading cranberry bogs where they are very unwelcome. These can be easily secured in large numbers, and are better for planting than the spindling specimens from the woods. Another way is to sow the seed. After removing all the trees and brush from the place where a cedar stand is desired, when not too dry, it is best to burn over the surface, and then sow the seed mixed with dirt.

Among those species which grow with surprising rapidity, even on poor soils, and which may be easily propagated, the cottonwood or Carolina-poplar (*Populus deltoides*) deserves first place.

In speaking of this tree in his bulletin on the cultivated poplars, Prof. Bailey says: "Taking all things into consider-

ation, the cottonwood is probably the best of the poplars for general ornamental planting. It grows rapidly and in almost every soil, and yet it possesses an air of strength and durability which most of the poplars lack. Its foliage is always bright and glossy, and the constant movement of the broad, rich green leaves gives it an air of cheeriness which few trees possess. The tree has been much used upon the western prairies and in western towns much too abundantly for good landscape effects. The rapid growth of the tree gives a feeling of luxuriance to plantations, even when most other trees appear to be weak or starved. The cottonwood grows best upon rather low lands, and yet it is generally an admirable tree upon high and dry areas."

The so-called Carolina-poplar, according to Prof. Bailey, is only a very luxuriant, cultivated form of the cottonwood. Like the locust, the cottonwood has an extensive root-system, and reproduces itself profusely by means of root suckers. It is, therefore, excellent for holding the soil in place.

The wood of this tree is extensively used in the manufacture of paper, and there is no reason for supposing that the demand will not increase. This tree grows perfectly on the moist pine-barren land of Southern New Jersey, and I can see no reason why its cultivation should not be encouraged.

Throughout southern Europe the poplars are extensively planted by the owners of small holdings. These tall straight trees form a characteristic feature of the French and Italian landscape. They prefer poplar, because the trees are easily produced from cuttings, because they soon grow to a size fit for boards, because they yield the peasant loppings for fuel, and because they throw so little shade that grass and other crops will grow between the rows. Plate XXIV shows a peasant binding poplar loppings in fagots for fuel, and a peasant sawing boards by hand from poplar logs which he has probably raised from cuttings of his own planting.

This leads us to the consideration of those persons who possess small tracts of land in South Jersey out of which they must earn a livelihood. The land has been undergoing such a process of division of late that the average land-holder probably owns little more than a hundred acres. The day of the large farm in New

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Plate No. XXIV.



BINDING TWIGS INTO FAGGOTS



SAWING BOARDS BY HAND IN FRANCE



Jersey is past. Owing to its nearness to excellent markets, general farming is being replaced by a more intensive form of agriculture, and old-fashioned crops are being replaced by specialties.

Hundreds of uneducated emigrants have invaded the Pines, owing to the cheapness of the soil and proximity to large cities. Few of these have brought with them European forestry ideas, and many of the most disastrous fires are those which they carelessly set in clearing their farms. Throughout this region there are German, Italian, Russian and other foreign colonies. By thrift and frugality many of these have produced fruitful farms on soil that was formerly waste-land, indeed it is claimed that owing to the warmth of this silicious soil, the fruits are earlier and sweeter.* It may be easily worked with one horse and few implements at any time when not frozen, and when abundantly fertilized and watered produces a superior grade of fruits and vegetables.

What the small farmers have already accomplished in this region demonstrates, without a doubt, that there are many latent possibilities in the pine-lands of New Jersey. Owing to the development of rapid transit and the cheapening of transportation rates, a migration from the cities into the neighboring country has begun. A large proportion of cultivatable land, therefore, is destined to be cleared and farmed, and to these prospective farmers I would suggest a "forest farm."

Suppose a person possesses one hundred acres of woodland, out of which he wishes to make a combination forest and farm. The first step is to clear a fire-lane around the whole of it, at least two hundred feet in width. This lane should constitute the cultivated portion of the farm. On this no inflammable crop should be planted.

Even the sandiest, driest land, when fertilized with the quickly disintegrating pine-chats, produces a fine grade of sweet-potatoes, which are richer than the white-potato, and together

* It is very difficult to say just what lands are unfit for cultivation. Good agricultural soil may often be unfit for trees and *vice versa*. Even the "Plains" of New Jersey would, if properly treated, produce choice grades of grapes, berries and sweet potatoes, and perhaps other fruits. In North Jersey the choicest peaches are produced on what is apparently the roughest and most inhospitable soil. Many Italians have thrifty fruit-farms on extremely sandy soil in the southern part of the State. A large percentage of the best land in Southern New Jersey is still in forest. In fact, in early times the land easiest to clear was cleared first regardless of the quality of the soil, and many of our finest farms were once true waste-lands.

with game, fish and berries often constitute the whole food of the natives.

If the one hundred acres referred to is perfectly square, a fire-lane two hundred feet wide around it would contain about thirty-five acres—as much as one man can comfortably till. There would be left in the center a forest containing about sixty-five acres to which the principles of silviculture I have already mentioned may be applied.

If the whole area of woodland in Southern Jersey were treated in this way, sixty-five per cent. would be left in wood, and the whole would be cut up in such a way that extensive fires would be impossible. The sixty-five acres of forest should be divided into about four blocks of fifteen acres each, by lanes or avenues wide enough to permit a wagon to pass. These lanes should be kept clear of litter during the fire season. If part of the land is swamp-bottom the owner is fortunate. He can easily have a white-cedar hurst, a cranberry-bog and an osier-holt, which will add materially to the profits of his farm.

Owing to the fact that these swamp-lands shrink and become lower and damper on being tilled, unless assiduously drained it is better to plant crops which need little or no cultivation, such as forest crops, willows for baskets, the high-bush-blueberry and the cranberry.

Willow culture is destined to become an important industry in this region. The first to begin it on damp pine-barren land was the Baron de Hirsch Colony of Russian refugees. The willow has been rightly called the Cinderella of trees. It will grow on land which for other purposes is almost hopeless. Its pliant twigs are excellent for trunks, boxes, crates, etc., besides baskets. It furnishes work at a season of the year when there is little else to do. It is a good plan, as is common in Europe, for one member of the family to learn the trade of basket-making. In this way a local industry is produced.

In addition to these industries, if progressive, the owner of the "forest-farm" could keep both bees and poultry with profit, even in the most remote and barren part of this whole region.*

* Every enterprising farmer should have in the corner of his garden a permanent seed-bed. It should be boxed on the sides and ends with wide strong boards and covered with fine poultry netting which should be nailed to a frame so that it can be easily removed. The soil of the bed should be a soft, rich, sifted loam. Whenever the farmer in his travels finds seeds of trees which are desirable he should sow them in this bed. While the trees are still small he should transplant them to his wood-lot. In this way, little by little, and with the expense of only a little labor, he can supply himself with seedlings and gradually improve the condition of his forest.

Apiculture, although it requires considerable skill in manipulation, should be a subsidiary forest occupation. This has been strongly recommended to the forestry people throughout Europe who have their homes in the forest. In South Jersey there is abundant bee pasturage. The locust, the linden, the catalpa, the chestnut, the red-maple, the hazel, laurel, huckle and blue-berries, grape vines, willows, holly, persimmon, magnolia and a host of other plants, yield honey, or pollen. From pollen bee-bread is manufactured on which the larvæ are fed. From buds, etc., the bees collect a viscid glue, or propolis, with which they strengthen their cells, and fill up the cracks in their hives as a protection against cold.

In order to secure a fine type of bee it is necessary to supplant the native queen with one of a better variety, either Italian or Carniolan.*

Besides gathering large quantities of honey, bees materially increase the fruit and seed crops by fertilizing the flowers.

Poultry-raising is also an important subsidiary occupation. In the dry soil and mild climate of the Pines chickens and turkeys, and along the rivers water-fowl, thrive, securing throughout a large portion of the year their own livelihood, and at the same time do incalculable service to the forest farmer in restraining insects.†

It is, in short, through a combination of several of these industries, which are minor only in name, that forestry and farming may become profitable on soil which is not naturally fertile and where many people own only small areas.

The destruction of vast areas of forest without regard to the future has a deleterious sociological effect upon the standard of life and character of the people of such regions. In South

*The domestic bee in America (*Apis mellifica*) was introduced by early settlers from Europe. They have multiplied and become common. The Cyprian race from the Island of Cyprus has produced the largest yield of honey on record for a single colony in America. They are the most assiduous of bees, but are very sensitive and require great care in manipulation. The Italian variety is also famous and easier to handle. The gentlest of bees, however, is the gray race of the Mountains of Carniola (Krain, near the Adriatic) in Austria. This bee is steadily growing in favor in America. See "The Honey Bee," by Frank Benton, publication of the U. S. Dept. of Agriculture.

† While visiting the Dunes of Holland I was told that hens were successfully used to combat an insect which devoured the sedge which held the sand. They were kept on the dunes in large quantities and as early as three o'clock in the morning were actively at work. I was also told by several willow-growers in Europe that when their plantations become infested with insects they simply let in their chickens, which soon devour the bugs. One of the most beneficial fowls in this respect is the turkey.

Jersey, for instance, owing to the exhaustion of saw-stuffs there are many deserted hamlets and silent sawmills. It is true that on the whole the population is on the increase, but this is due to another class who have come from elsewhere with other abilities and other objects in view. Many of the natives, however, who were born and bred in the forest and earned their livelihood in the woods have been forced to leave for other regions and engage at a disadvantage in other work. The few who have remained of this class are in a state of stagnation, and in many instances, were it not for the berry crop and the game in the woods, would die of starvation. Owing to the fact that they are idle a large part of the year, that they are far from neighbors except of their own class, that they are often insufficiently fed and clothed, there is little wonder that many are outlaws. The backwoodsman without work is the man who sells his vote. The common schools of America are endeavoring to educate such people, but much of the good influence is offset by the industrial depression which follows the wasteful destruction of wood in a country where the majority of the people are woodsmen. Just as reckless deforestation inevitably leads to idleness, want and moral degeneration among those dependent upon the woods, so does afforestation have the opposite effect in the same if not greater proportion.

Then, too, the value of forests from a hygienic standpoint on swampy soils has been underrated. I believe the malarial condition of our South is due to the ill-treatment of forest lands and the formation of stagnant marshes in consequence. It is a noteworthy fact that the Dismal Swamp of Virginia and North Carolina is free from malaria and perfectly healthy, while the adjacent fire-swept pine-lands are famous for their unhealthfulness. Just as the Landes of France were rendered healthy by tree-growth and drainage, so is it possible to improve the sanitary condition of the Atlantic Coast Region.

III. Parts of Europe Similar to Southern New Jersey.

In Europe there are still immense tracts of waste-land, a large proportion of which has been robbed for centuries, until much of it is now in a state of extreme poverty. The majority of this land is worse, although similar, to the Plains of South Jersey. The system of removing not only the turf but the surface soil from these wild-lands is ultimately worse than the effects of forest fires. A forest fire in sweeping over a country leaves something behind it. The inorganic materials which the plant took from the soil are returned to it in the form of ashes, and although a part of them may wash away, something is left; but in the heathlands of northwestern Europe the very surface of the earth is scraped together, so that in the course of time the soil becomes bare and sterile. We usually think of Europe, and especially Belgium and Holland, as the places of all the world where every spadeful of earth has been turned over hundreds of times, and where every effort has been exerted to provide room for its swarms of people. One is surprised, therefore, to see a new settlement called "America" in the midst of a great unsettled plain in Holland. There are, in fact, in this little country, from four to five hundred thousand hectares* of waste-land, which consists of heath, moorland and morass. The Dutch prefer, and perhaps wisely, to grapple with the mud and water along their shores. They would rather farm into the jaws of the sea than work on their dreary heathlands. Mr. Schober, at Schovenhorst, has been striving for years, at great expense and with great perseverance, to show what is possible on the heathlands of Holland by careful cultivation and improved methods. But just as the Swiss loves the steep mountain sides, so does the

* Centare (1 sq. meter)=1,550 sq. in. Acre (100 sq. meters)=119.6 sq. yds. Hectare (10,000 sq. meters)=2,471 acres.

Hollander love his muddy soil. This soil, although difficult and expensive to reclaim, when once in shape is almost inexhaustibly fertile. The fine sandy land of Holland has also been carefully cultivated, and the dunes along the shore have been carefully watched and patched here and there because they serve as dykes along the sea. One of the most attractive regions of the Low Countries is in the lee of the Dutch dunes, where there are many beautiful villas and gardens.

Although much has been done toward the reclamation of waste-lands, the common notion that every inch of territory in Europe is used to good advantage is a mistake. In fact, Europeans could learn much in reference to land reclamation even in the United States, where good land is still cheap and abundant. Much has been done, for instance, in this line in the banked lands of the Mississippi Valley and the irrigated deserts of the Far West. There is little that one can learn in Southern Europe outside of France and Italy, except the disastrous effects of deforestation. Although much that has been done in Europe is highly commendable and suited to the peculiar conditions which exist there, it would be difficult to say just how much of it is applicable to America. There is one important difference between the New and Old Worlds which should not be overlooked in all considerations and calculations. It is the fact that in general in Europe labor is cheap and materials expensive; in America the reverse is the case. Much of the detailed and extremely careful work which is devoted to small and unimportant things may pay in Europe but not in this country. One cannot help admiring the pains and patience of these people, but at the same time in another country, under different conditions, they would themselves do otherwise. Carefully saving and binding together small sticks into bundles for fuel is all right for the places where fuel is scarce and expensive, but would be decidedly out of place in America. European sawyers are horrified at the sight of a circular saw with wide kerf buzzing at a rapid rate and wasting a large proportion of the log, but it saves time, and time has been up to the present more precious than wood.

Europeans are generally conservative, especially the peasants, preferring to do as their fathers did, working often to great dis-

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advantage with implements which are decidedly clumsy. And then, too, all sorts of traditions and customs, rights and servitudes have been handed down from generation to generation. The poor peasant is often fettered by these inheritances, which he joyfully leaves behind him when he enters a new and fresh land.

In parts of France forest fires are still quite common, even on land which has been reforested, while in other parts wood is too precious to burn even for fuel. In Italy lumber is one of the scarcest of materials, although there are vast areas of waste-land where wood could be raised to advantage, especially on the bare mountain peaks. It is a land of few wood-workers and many masons, where even the vine-props are often granite.* The supply and demand are more local in Europe, and transportation suffers from all sorts of hindrances. A board would pass through more vicissitudes in going from Germany to Italy than a bundle of shingles would in reaching New York from Oregon. This is not so of water transportation, which is of course less hampered by governmental interferences.

In many districts in Europe the inhabitants depend upon turf for fuel, which exists in almost exhaustless quantities in the heathlands of the north, and even in Germany it is not uncommon to see peasants drying cow-dung for the purpose.

In parts of the Plain of northwestern Europe, under the peat, have been found pine stumps and the stone implements of the aborigines. Another page in its history is illustrated by oak stumps, among which have been found bronze axes and other implements. Here and there are beds of peat buried under the sand, indicating that the soil has been shifted hither and thither by the wind. It is generally believed, however, that the great heathlands of northwestern Europe were never densely forested, and that the trees existed in the form of groups here and there. Such places were well suited to the nomadic pastoral stage of man's existence. This, to a certain extent, still lingers in the form of the shepherd tending his "snucken" or little black sheep on these broad heath-covered plains. There, too, one often sees a bee-keeper surrounded by many hives of little black bees, which he moves from place to place for fresh pastures.

* "Forestiere" in Italian means a stranger—that is, a person from the forest.

The Belgian Campine.

The first region that I shall refer to is the Belgian Campine, a large tract of sandy land in the vicinity of Antwerp. In wandering over this region one sees much that reminds him of the plains and barrens of Southern New Jersey. The bushy oaks, the scrubby pines, sandy or gravelly soil, and many plants of the heath family which cover the surface, are strikingly similar to those of Jersey. Here and there in this region are small houses of the Flemish farmers who often have a hard struggle in squeezing a livelihood out of the soil. Most of these peasants plant forests of pine with short rotation from which they get humus for their compost heaps and fuel-wood. It is not uncommon to see a woman and a dog in harness tugging together at a load of manure, or a man in the field plowing with a cow which is usually at the same time milked. The house and barn of the peasant are combined, and the manure-pile, which is close to the door, is his most precious possession. Now and then green manuring is practiced, and a field of yellow lupine* is quite as beautiful as a field of crimson clover.

Much that I have to say here in reference to the Belgian Campine was suggested by a little book entitled "La Culture du Pin Sylvestre en Campine," by L' Abbé G. Smets, professor of agriculture at Hasselt, in Belgium. To this I have added my own impressions and have compared the two wherever possible. A large number of the Belgian Scotch-pine (*Pinus sylvestris*) plantations leave much to be desired. The trees are stunted and grow to a height of only a few meters. The volume growth rapidly attains its maximum, and even at the age of twenty years some of the forests begin to die. Parasites are abundant.† There are few old trees; the quality of the wood is poor and the best stands, according to Smets, yield small profits.

* I have endeavored to grow this lupine (*Lupinus lutea*) in South Jersey from seed bought in Holland, but it failed to flourish both on good and bad soil, owing probably to the dryness of the summer. Our purple lupine (*Lupinus perennis*) is worthy a trial on very poor, sandy soil.

† In the pine forests of Northern France and Belgium a wood-eating insect known to entomologists as *Hylesinus pini perdo* attacks the pine in swarms. This little beetle bores into the young branches and tunnels along the medullary canals. The wind snaps off the damaged twigs, and now, in some pine districts, the forest floor is fairly strewn with the debris. The insect develops very rapidly under the bark of felled trees, and it is found that barking the logs immediately after they fall under the axe prevents the spread of the pest.

M. Houba says, however, "that one must not expect too much of plantings on waste-land, and that the revenues from the poor-lands of the Campine and Ardennes are equal to five per cent. on the capital invested." (If American capitalists could make *sure* of five per cent. there would be large investments in forest land.)

Heathlands, which have not been exhausted by the removal of the humus, have produced satisfactory forests. "Nothing is sadder," says Verstappen, "than to pass over certain wooded zones of the Campine, to-day offering a spectacle of decay which seems without a remedy. Where thirty years ago one saw superb pine groves yielding as much as the best wheat-lands of Hesbaye, now one sees only rare groves of third and fourth grade, while the greater part of the surface is covered with a growth not exceeding three to five meters in height." Levasseur says that a good plantation of pine properly managed, well located, should yield, at the end of eighty years, 27,175 francs per hectare. That is, according to our system of measurement, \$2,174. per acre, or \$27.17 per acre per year! Prof. Smets estimates a yield of from 1,500 to 4,000 francs per hectare in a period of 30 to 40 years for the Belgian Campine. That is about a yield of \$4 per year per acre for this poor heathland! If these figures are correct, the wonder is why every inch of that land has not been reclaimed.

The Scotch-pine will grow under a great variety of conditions. It is not very sensitive to frost and accommodates itself to low and damp places. It is a tree of the vast plains with silicious bottom and deep soil. It is a species easy to satisfy and has been successfully transported to many countries into many soils. It is probably the most widely spread of all the pines. It is like the red-cedar of America in respect to endurance, growing in wet and dry locations, in hot and cold, on mountains and in the lowlands. Very rarely, however, does it reproduce itself naturally.

Here and there, at a certain depth, a bed of impermeable clay or heath-humus buried under eolian sand arrests the growth of the trees. These beds do not exist everywhere and their bad effects may be overcome by thoroughly working and softening the soil. This all tends to prolong the life and vigor of the tree

and render more available the nutritive elements of the soil, but even plantations the soils of which have been carefully prepared before planting, produce results which are far from satisfactory. "The poverty of the soil," says Smets, "is the general cause of the failure of the pine in the Campine." The idea has prevailed that the Scotch-pine can succeed everywhere, that it only demands a trace of nutritive elements, that every soil suits it. Although the demands on the soil by this pine may be less than other forestal species, nevertheless a soil may reach an almost hopeless sterile stage after years of cropping by the removal of wood and the surface humus and soil. It is well known, too, that trees on such soil are more subject to disease and quickly succumb. They are simply stunted by starvation. Young trees en masse are, it is said, as exacting in their demands upon the soil as a crop of rye.* Although, as I have already said in the previous chapter of this report, very little reliance can be placed in the chemical examination of a soil, the absence of one essential ingredient may compromise the whole crop. When a tree grows rapidly and reproduces itself abundantly, as occurs in the pine-lands of South Jersey, it is evidence enough, without chemical examinations, that the soil is in good condition, no matter how barren it may appear. In the Plains of South Jersey, which are treeless, only one essential may be lacking or the difficulty may be a physical one. According to Schütze, pineries may be classified as follows:

	Phosphoric Acid, Per cent.	Potash, Per cent.	Lime (Chaux), Per cent.
Pinery, 1st class,	0.0501	0.0457	1.8876
" 2d "	0.0569	0.0632	0.1622
" 3d "	0.0388	0.1221	0.1224
" 4th "	0.0299	0.0392	0.0963
" 5th "	0.0236	0.0241	0.0270
" 6th "	0.0236	0.0215	0.0458

The Expt. Station Record gives tables which, in general, show the limits assigned to rich and to poor soils. They are as follows:

* The sands of the Golden Gate Park were so poor in nature that barley sown on its surface after being ploughed and cultivated in a favorable season with plenty of moisture, grew only about six inches in height and failed to perfect its seed. After planting sea grass to fix the sand and lupines to enrich the soil, the trees which were planted only grew to a height of ten feet, owing to the lack of nutriment in the soil. See the Reclamation of Drifting Sand Dunes, in the Forester, for October, 1899.

	Nitrogen.	Phos. Acid.	Potash.	Lime.
Very poor soils,	0.05 %	0.01 %	0.05 %	0.10 %
Poor soils	0.05-0.10	0.01-0.05	0.05-0.10	. . .
Medium,	0.10	0.05-0.10	0.10-0.20	1.00
Rich,	0.10-0.20	0.10-0.20	0.20-0.30	. . .
Very rich,	0.20 up	0.20 up	0.30 up	2.00

According to this the treeless Plains, as far as the soil is concerned chemically, except in the quantity of lime, if these analyses are correct, have a first-class pine soil. The soil of the Jersey Plains contains the following ingredients :

	Sample I.	Sample II.
Nitrogen,	0.06	0.03
Phosphoric acid,	0.07	0.065
Potash,	0.05	0.02
Lime,	0.06	0.02
Silica, insol.,	96.40	96.95
Alumina,	1.15	0.28
Ferric oxide,	0.40	0.20
Ferrous oxide,	1.26	1.06
Magnesia,	0.04	0.02

According to Smets, the soils of the Campine contain the following proportions of ingredients :

	Azote.	Phosphoric Acid.		Potash. *		Lime (Chaux).		Magnesia.	
		Sol. in H cl.	Insol.	Sol.	Insol.	Sol.	Insol.	Sol.	Insol.
Pine land,	0.06	0.013	. . .	0.013	0.648	0.004	0.959	0.023	0.260
Pine land	0.040	0.012	. . .	0.032	2.026	0.055	0.950	0.033	1.291
Cult'v'd soil,	0.122	0.034	0.010	0.005	0.459	0.027	0.624	0.011	0.052

According to these analyses, even the Plains of South Jersey, if ploughed and worked, then planted with a leguminous crop, then ploughed again and limed and then planted with pines, would probably produce a good crop, provided the soil is not too dry. Very often a leguminous crop, such as cow-peas, may not take the first trial owing to the absence of bacteroids in the soil so that several attempts may be necessary. This probably would not pay, but it would be an interesting experiment. It

is claimed by many that forests do better on soils which have been cultivated for a time. The soil is mellowed by the process of cultivation, and the inorganic materials which have leached through the surface during the process of cultivation are reached by the roots of the trees. Pines which spring up in old abandoned fields are very vigorous, and in Virginia signs of the old corn-rows may be seen in forests on land which produced cotton and corn up to the time of the Civil War. At the same time the materials which have escaped the field crop by leaching are brought again to the surface by the tree so that the soil is being rendered fit again for agricultural purposes. The forest is thus an important factor in the rotation of crops, as I have already explained in the first chapter in connection with the eastern shore of Virginia. Although the farmers in that region remove the litter, they wisely allow old fields to come again in pines and clear fresh pine forest. By making the rotation of the pine short, the growing of pines in the sand-lands of the South may in time play an important agricultural rôle, and may, as one in the series of several crops, be necessary to maintain the productiveness of the soil.

It must not be forgotten also that the roots of trees corrode even the silicates, and coarse sandy soil, under the influence of vegetation, becomes gradually loam-like in nature, although clay may be lacking. For this purpose pines have great advantages in that they are adapted to sandy soils and that the stumps soon rot after the tree is cut. It is not a difficult task to clear a pine forest for agricultural purposes. In planting old fields the surface should be plowed under in order to bring fresh soil to the top. The young crop demands a rich surface-soil; later, when the roots penetrate into the subsoil upon which the tree feeds, it can take care of itself. Smets recommends, therefore, the growing of young plants in nurseries in good soil first, and claims that the so-called hardening of plants by growing them under adverse conditions is a mistake. This is, of course, expensive, and is not necessary in a country where a good crop is usually produced naturally or may be easily produced by sowing.

There is formed in the heathlands of the Campine a peculiar powdery dry light-brown or black humus which decomposes with difficulty and collects in thick beds. It is formed mainly

by the stems and roots of heather. It is acid or sour in nature and sufficient alkali to neutralize it is lacking in the soil. It is, in fact, antiseptic in nature. This kind of peat does not form in Southern countries except in mountainous regions. The peat which is formed in the swamp-lands of New Jersey is of a very different nature, decomposing quickly, being comparatively mild or easily converted into a good fertile condition by drainage and cultivation. This mucky land is one of the best forest soils in New Jersey, being the home of the white-cedar (*Chamaecyparis thyoides*), our choicest soft-wood.

According to Smets the rôle of the pinery should be to prepare anew the soil which has been exhausted on the surface by agriculture or by the removal of humus.

Smets concludes that if the heathlands of the Campine are cultivated for a time, enriched by lupines and lime, and then planted with pine, they will produce fair forests, provided the humus and litter are not removed. In Hungary the pineries are limed.

In reading the government reports in reference to the Campine I have concluded that what is accomplished in Belgium in this line is accomplished under difficulties. The struggles we are having in America are no greater than those of other countries. There has been commission after commission, report after report, with all sorts of recommendations. In 1898 there were still 173,000 hectares of unreclaimed heathland in the Campine.

As an illustration of the peculiar difficulties encountered I shall mention "bud-stealing," which, although recent, is serious in its consequences. These pine buds, which are used in liquors and medicinal preparations, are collected and sold by the peasants. Whole families work at this industry, silently in the night, in young forests, in the springtime. The tree, when robbed of its terminal bud, grows crooked, and if the process is repeated stops growing and finally dies.

I shall conclude this section with the statements that with the exception of the Plains the whole of South Jersey is quite equal in timber-producing qualities to the better portions of the Campine. Some of the finest forests of the world, in fact, are on soil no worse than the Jersey sands. The magnificent forest

of Fontainebleau (40,000 acres), for instance, is on a bed of dry sand. Remove this forest, and 98 per cent. of it would become a desert of drifting sand. It should always be borne in mind that sandy soils in regions in which there are sufficient warmth and humidity, if left to nature and freed from the pernicious interference of the human species, fires and browsing animals, will in the course of ages become forest-clad and fertile. By forest-clad I do not mean a meagre growth of trees and bushes, but a rich, dense forest, with a soil which, under the influence of leaf-mold, will ever improve in quality, both physically and chemically. By the application of skill and knowledge this process may be, of course, hastened. There are French foresters who have said that were it not for the camels and Arabs of the Sahara the oases of vegetation would have gradually spread and covered a large proportion of that barren waste. On the other hand a magnificent forest on fertile, sandy soil can be quickly converted into a sterile desert by the reckless removal of fertility from the surface. Those lands in Southern New Jersey which are being subjected to the same or similar processes through which the Campine of Belgium has passed belong to the Beacon Hill Formation, which is mapped and described in the Annual Report of the State Geologist for 1898.

In referring to this region, Mr. Knapp says: "In the vicinity of Hammonton many clearings have been made on this formation and have been found to be profitable for the cultivation of berries. It is possible that considerable tracts elsewhere might be used in the same way, but at present a very small proportion only of this formation is in cultivation. The formation as a whole seems to invite forest culture rather than the ordinary form of agriculture." He also assures us that although the soil is coarse, loose and white, its surface appearance is worse than its real character.

The Dunes and Landes of Gascony.

In this chapter I shall refer mainly to the Dunes and Landes of Gascony, one of the stereotyped examples of the complete reclamation of an almost uninhabitable and unproductive wasteland. The two principal works I have consulted on the subject

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NATIVES OF THE LANDES



A CHURCH WHICH WAS BURIED BY THE SAND ON THE FRENCH DUNES

are "Les Landes de Gascogne," by M. Chambrelent, and "Les Landes et Les Dunes de Gascogne," by M. Grandjean.

In the early part of this century (before 1857) the condition of this flat triangular plain, known as the Landes, which is roughly bounded by the Bay of Biscay, the river Adour, and the river Garonne and the Medoc, was, in brief, as follows: There were miles of marshy, almost treeless wastes, covered mainly with a low, dense growth of herbage. It was wet, unhealthy and sparsely inhabited. The few people who lived there depended upon their flocks. The accompanying picture shows a native of the Landes standing upon stilts watching his flock. (See Plate XXVI.) He is dressed in a heavy sheepskin paletot. By standing on stilts these shepherds can easily see their sheep in the herbage and can easily follow them through wet and marshy regions. Their spare time is spent in knitting stockings. The condition of the Landes was due to the immense sand dunes which arrayed themselves along the shore of the Bay of Biscay. They moved inland, covered villages and occluded inlets. The damage done by these moving sands so increased that the government officials studied the work and devised and executed plans, and now, thanks to de Villers, Chambrelent and Bremontier, the pioneer workers, the Dunes and Landes are covered with a beautiful growth of the maritime-pine. The region is now a famous health resort, combining the beauties and pleasures of the seashore with those of a well-managed pine forest which extends almost to the edge of the ocean.

There are evidences that the Dunes were naturally originally fixed by forests. These forests were destroyed by vandals and all attempts failed to stop these menacing mountains of sand. In 1778 a talented engineer, Baron Charlevoix de Villers, was sent to Arcachon for the purpose of forming a military post. He saw at once the necessity of fixing the sand, and was, according to Grandjean, the first to establish the fact that the way to fix the dunes is by the means of plantations of pine. He met with troubles in his work and was finally sent back to the Island of San Domingo.

In 1784 Bremontier began the work and, it is said, by using the result of de Villers' labors, finally succeeded in fixing the moving sand.*

* Bremontier tells of a dune which advanced, in a violent tempest, at the rate of two feet in three hours.

Plate XXVI shows a church at Soulac which was buried by the sand.

The methods employed in fixing the dunes may be briefly described as follows :

A littoral dune was constructed straight along the shore from the mouth of the Gironde to Bayonne. This dune was the secret of the success in the fixation of these shifting sands. It is simply a bank of sand of certain dimensions, with a certain slope suited to the condition of affairs. This protective, or littoral, dune is formed as follows: a double fence is constructed of brush,* or of palisades driven in the sand. This stops the sand which comes from the ocean. Soon a ridge of sand forms, equal in height to the fence. A double fence is used, as it gives breadth to the dune, and stops the sand which blows through the fence on the ocean side. As soon as a ridge of sand is formed as high as the fence, the old fence is pulled up, or a new one built on top; and so on, until a dune of the height desired is formed artificially. The proper height of a protective dune is 33 feet. It should slope 25° towards the sea, and may be 60° on the land side. The dune must be at least 300 feet from high-water mark. After the dune has reached the proper size, it is kept in shape by the sea marram (*Psamma arenaria*).† This peculiar plant, called *gourbet* in France, is exclusively used for fixing the sand on the littoral dune. It has long, much-divided rhizomes, and will grow well only when covered with fresh sand. The dune must always be kept in shape. If sand accumulates in any one spot in undue amount, a draft is formed, which may end in a breach of the littoral dune. *Gardes cantonniers* are stationed along the dune, to watch it closely, and here and there on this long, straight sand-bank groups of men and women may be seen digging up the *gourbet* in places where it is too thick, and planting it where needed. Constantly the dune is watched and mended; the forest, villages and fields in its lee are dependent upon it, and it in turn is dependent upon the humble, but persistent, *gourbet*.

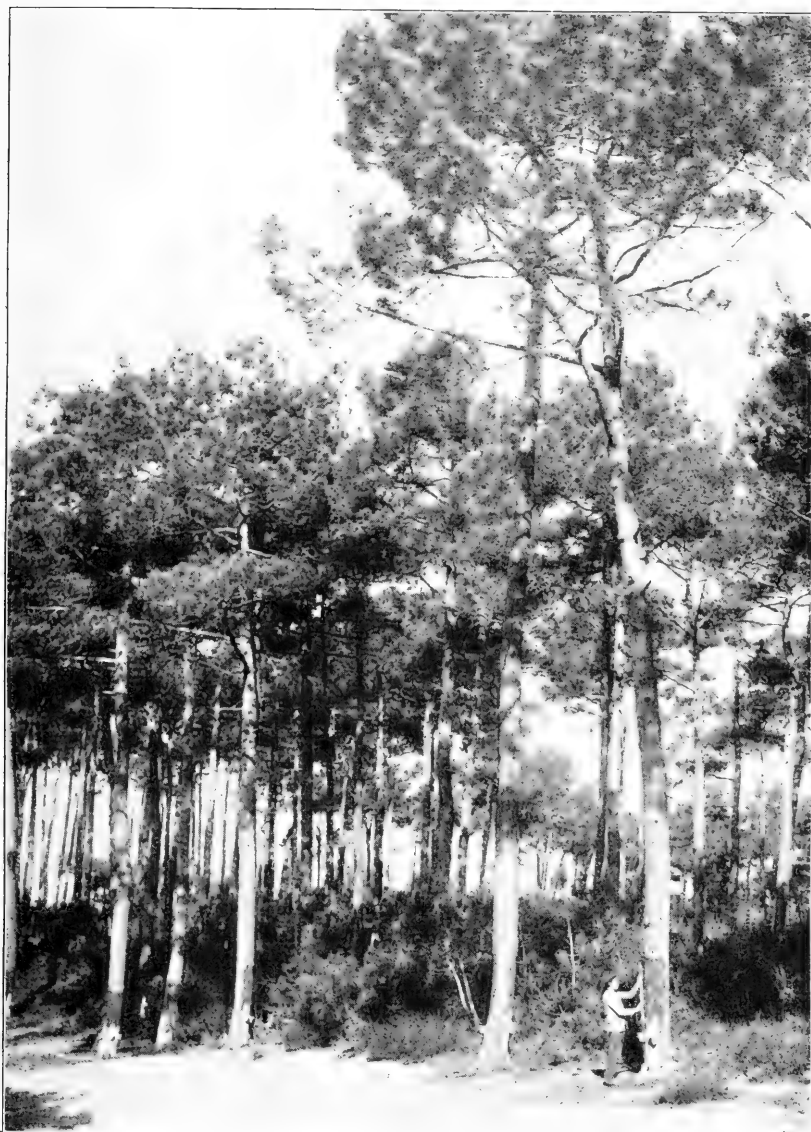
After the formation of the littoral dune comes the work of

* This system of making a fence of brush is called *Clayonage*.

† *Psamma* or *Ammophila arenaria*, beach or marram grass is the best known of the true sand-binding grasses. (See Sand-binding Grasses, by F. Lamson-Scribner, in year book of the Department of Agriculture.) It is common on the Atlantic coast of both Europe and America.

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FOREST ON THE FRENCH DUNES NEAR ARCACHON



planting in its lee. The surface of the sand is covered with brush arranged like the slates on a roof, with a shovelful of sand here and there to hold it down. Then the seeds of *Pinus maritima* are sown, with seeds of other plants to shade the young pines. The pines usually come up well, and grow quickly, although close to the littoral dune they are gnarled and stunted by the salt winds. Thus the sands are fixed, and, although the forests do not yield a large interest in cash, they are of incalculable value to a large proportion of the people of Gascony—in fact, indirectly, to the whole of France. Fire-lanes have been constructed across the dunes, and, thanks to the watchfulness of the guards and the rigid enforcement of laws, fires are not frequent. Owing to a lack of roads and means of transportation on these dunes, only the most valuable timber is marketed after being tapped for resin. If it is desirable to remove a tree, it is bled to death before being cut.

The fixation of the Dunes rendered possible the work of M. Chambrelent, which was the reclamation of the Landes by drainage and plantings. It is a unique example of personal initiative. M. Chambrelent, a young engineer in the Department of Bridges and Roads, in 1837 was sent to Gironde to study the drainage of 800,000 hectares of land in the districts of Gascony and the Landes. His conclusions were not accepted, so he bought some land and put into effect the measures he advocated. In 1855 the results of his experiments were submitted to an international jury. The jury was so favorably impressed that it recommended the application of Chambrelent's plans to the entire region, and in 1857 a law was passed requiring the Communes to do this work. The Communes paid for it by selling a part of this land which increased in value after the completion of the work. This region was one hundred meters above sea level, flat and sandy. It was underlain with a hardpan called "alios." In summer it was a bed of burning sand, in winter constant inundation; and between the two a period of pestilence. The country was characterized by its sterility and insalubrity.

A complete system of drain-ditches was dug and the seeds of *Pinus maritima* sown. In 1865 all works of drainage were complete. The pines grew with extraordinary rapidity. The

"alios," which formerly arrested vegetation, in no way impeded growth. It is a sandstone, not entirely impervious, and served to hold the moisture during the dryness of summer. It was feared that the inability of the tap-root to penetrate this hardpan would arrest the growth of the tree, "but," says Chambrelent, "the uselessness of the tap-root* has already been demonstrated. It extends to inert soil which receives no atmospheric influences. It really plays only a mechanical rôle for holding the tree in place, but in close growth is not necessary, because the trees support each other."

He also notes the fact that in spite of very rapid growth the wood is of superior quality. In another place he says that, owing to its elasticity, the poles are in great demand in England for mine props, also that because of its rapid growth, the absorption of copper sulphate is facilitated, which renders it durable and valuable for telegraph poles. In speaking of the sanitary effects of the forest he says that "the Landes, which in 1865 were pestilential, are now as free from fever as the most favored regions. The presence of so much wood enables every household to have generous supplies for heating and drying in cold and wet seasons. An investigation of the causes of agricultural depression in other parts of France only too clearly indicates the inestimable benefit of large wood-supplies for domestic purposes."

During the Civil War in America, France enjoyed a broad market for her naval stores at three times the normal price. Owing to the cheapness of the inferior American product, *gemmage* or tapping for resin is not very profitable.

Such was the work started by Chambrelent. By allowing a revolution of thirty years to the pine crops it may go on forever, provided forest fires and insect pests are kept in check. Plantations of coniferous species in all dry countries are always in danger of fire, and forests of one species only are often completely devastated by insects.

By the fixation of the Dunes 650,000 hectares of land were made productive. Formerly if one wished to buy land, he mounted a hill and called in a loud voice; the land over which his voice carried was worth twenty-five francs.

*Gardeners often remove the tap-root of trees in order to stimulate the horizontal root system and to facilitate transplanting.

"A man," says Grandjean, "was forced to take some of this sand for a debt. He became a millionaire later by selling it in small parcels." The first summer the visitors lived in the resin cabins; now every luxury is afforded to the two hundred thousand tourists who come there every year.

To-day it is a health resort. It is covered with pines and is prosperous. Although a few severe fires* occur now and then, and owing to a lack of roads or other sufficient means of transportation all the wood is not sold, nowhere in the world, however, are the following industries more extensively and scientifically developed: Collection and manufacture of naval stores, the impregnation of wood with preservatives, and oyster culture. They have also demonstrated that there is no better way of fixing shifting sands, of draining swamps and removing pestilence than by forest-planting.

Destroy completely the forest which covers the Coastal Plain of Eastern America and it will become a bed of shifting barren sand, in places swampy, pestilential, unproductive, unsightly and unfit for habitation, although capable of producing under forest management an abundance of excellent timber and naval stores forever. Large areas of the Coastal Plain of America are rapidly approaching the former condition of the Landes of Gascony.

The eastern coast of America, under proper management, is, in this respect at least, capable of almost limitless prospects. The timber of the short-leaf, long-leaf, old-field and Cuban-pines finds a market even in Europe. Now that yellow-pine (or what they call pitch-pine in Europe) has won a reputation in other countries, it is only good business to see that the supply may not run short, but be more than sufficient for all possible future demands. Besides, there is and, perhaps, always will be more wood used per capita in America than elsewhere in the world. Just as Italy is the land of masons, America is the land of wood-

* After several fires in the Montagne Noir comes the announcement of fire in the Landes, spreading from the region of Laborheyre and Parentis-en-Born to Mimizan over thousands of hectares of pine-lands. An innocent man amused himself burning the herbage in the midst of a country terrified by the heat of dog-days near forests of pine. Hatred and ill-will incited criminal hands to imitate this example. The fire traversed thousands of hectares of forest, as in America, destroying everything in its way. It is astonishing, considering the slight attention accorded to the laws or restrictive regulations, that such disasters should not have occurred earlier, during the great heat of August. At last it rains!—*Revue des Eaux et Forêts*. (September, 1898.)

workers, where almost every boy knows how to use a hatchet and a saw.

Although the Landes are in the latitude of Nova Scotia, the climate is milder than that of Southern Jersey, so that the resin industry is possible. Arcachon is the combined Lakewood and Atlantic City of France. The largest city in the vicinity is Bordeaux. Just north of Bordeaux, between the Gironde and the Bay of Biscay, is the Medoc, famous the world over for its wines. The soil of this region is, I believe, not unlike that of the Cape May formation of South Jersey. At Verdon, on the point across from the seashore resort of Royan, is a beautiful forest of pine and locust on the dune sand, which was planted by Bremondier. In the forest of La Teste, near Arcachon, is a red marble monument in honor of this famous engineer—a fitting memorial to the man who fixed the sand of these shifting dunes.

In the Landes, in addition to naval stores and timber, oyster culture and apiculture are important industries. Small quantities of cork are also produced. Sheep raising is also an important occupation, and the mules and horses which are produced there, although small in size and tough, are gentle and excellent in quality.

Here and there men and women may be seen spreading boughs and twigs in the ruts of the roads and in the pathways to improve their condition.

The population of this part of France has rapidly increased. Just as reckless deforestation inevitably leads to idleness, want and moral degeneration among those dependent upon the woods, so does afforestation have the opposite effect in the same if not greater proportion. In the Landes, for instance, before the planting of forests a man could buy a farm for a few francs, it required over two acres to support one sheep. In less than a century the population sextupled, while that of a large part of the rest of the country either remained stationary or decreased. A few miserable shepherds were replaced by wood-workers, resin collectors, workers in establishments for refining the product and for impregnating wood, pleasure and health seekers, besides others who were attracted to do other business produced by the change of conditions. The population of a country generally increases in proportion to its natural resources. The fecundity

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of the French in places where there is plenty of room and opportunity is proverbial as in Canada. It is even so in the Landes, which, on being reclaimed, was equivalent to the addition of a new province or colony.

The Banat Sand-Desert of Southern Hungary.

Joseph Wessely, in his book entitled "Der Europäische Flugsand und Seine Kultur," gives an interesting description of the Banat Sand-Desert in Southern Hungary. This region is north of the city of Begrade, which is on the opposite side of the river Danube, in Servia. This great sand-plain was once a lake-bottom before the Danube had worn a deep passage, called the Iron Gate, through the Transylvanian Alps. Even in historic times these shifting sands were covered with forests. In addition to such records there are other evidences which indicate that the region was once forested. These are in the nature of buried beds of humus, lime caves, caused by lime-water settling in cavities of rotted tree-roots, and the names of places, as is often the case in treeless regions, indicate its former wooded nature. The Magyars, for instance, called this sand plain "Nyir" in their names, which signifies "beech."

The soil was not sterile in the sense of lacking inorganic ingredients,* but was of such fine, soft, sandy nature that on being divested of its vegetal covering was easily shifted hither and thither by the wind. Reckless cutting for fuel, the collection of sumac for tanning, and the browsing of many herds belonging to nomads soon despoiled even the few oases of vegetation which existed within recent times. In spite of many efforts to reforest this region, 30,000 of the 70,660 jochen † were bare desert. The greatest evil of all was the flocks and herds which wandered over this region eating the herbage, loosening the soil and exposing the sand to the action of the wind. In addition to these difficulties, there was a revolution in 1848,

*The sand of the fertile marl region of New Jersey is subject to drifting here and there. South of Philadelphia, from the Pennsylvania shore, it may be seen moving in clouds over the fields in New Jersey. The wind picks up the fine grains and leaves the coarse particles behind. This sand blast is, of course, very injurious to fields of young, tender crops.

†"Joch" is an old European land measure. It is the same as "yoke," and originally meant the amount of land a yoke of oxen could plough in a day.

which interfered with the work of reforestation. Wessely concludes by saying that little had been accomplished because of a lack of knowledge of sand culture and a lack of courageous and unselfish devotion to such work in spite of opposition and difficulties.*

This book appeared in 1873. Since that time there has been great progress. The work in this peculiar and secluded region is of great interest to Americans because it was accomplished under great difficulties, and because it was our own locust tree which was most successfully and extensively planted. In his book Wessely mentions that the Canadian poplar and the locust seemed at that time to be the most promising trees for the region, and that the Hungarian foresters often remarked that "Die Akazie sei in Nord-Amerika für die Ungarische Ebene eigens erfunden worden." †

There has recently appeared an article on the locust by the Hungarian Forester Bund in the *Zeitschrift für Forst und Jagdwesen*. The successful use of the locust on sandy land in the Rhine Province led him to inquire into the experiences with this tree in the Hungarian desert. This tree was at first only used in gardens and along avenues, but soon its good qualities were recognized as a supremely useful cover for sand surfaces. It is to-day principally the locust which relieves the monotony of the Hungarian steppes. In all there are at least 70,000 hectares or about 172,970 acres of pure locust stands in that country. It is, in his opinion, the tree of the future for desert sandy regions. The government is encouraging the planting of this tree by furnishing gratis every year from the State nurseries from five to six million young locust plants.

The chief claims for the use of the tree in Hungary are that its demands on the soil are slight, that it is easily propagated, and that owing to its extensive root-system and root-suckers it holds the soil in place. He recommends that the soil should be worked first, on which a crop of rye or legumes may be grown, and cautions one not to sow seeds which have been scalded or

* It is worthy of note how that in great reforms much has been accomplished by one or only a very few persistent, enthusiastic workers.

† "The locust has been discovered in America especially for the Hungarian Plain." The term "acacia" is used throughout Europe for the locust tree; in fact, in America, it is called "false acacia," from which comes its specific name "pseudacacia."

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THE FOLIAGE OF THE LOCUST



steamed unless the soil is wet. He says that in Hungary the wood is highly prized for many purposes, that the flowers furnish bee food, and that the tree suffers little from disease.

Throughout the Rhine regions the locust is grown as a coppice, with a 15-year rotation. The poles are in great demand for vine-props, and the net return is 80 marks a year for one hectare—a yield scarcely equalled by any other species of tree. The Minister of Agriculture has directed that the locust be planted on land which has been heretofore occupied by coppice oak, since the tan-bark industry is no longer profitable. The American government should offer a high prize to the entomologist who devises a means of exterminating the locust-borer. Were it not for the depredations of this insect the locust would be one of the most profitable and useful of trees for planting on the Jersey sands. It is specially fitted for the purpose because of its slight inflammability.

The Lüneburg and other Adjacent Heath and Moor Lands.

Our prevailing winds are from the land, and in spite of the fact that South Jersey is close to the ocean, the climate is dry in comparison with the plains of Northern Europe. Almost every summer we have a period of extreme drought which is very trying to all plants, the roots of which do not penetrate to where there is a constant supply of moisture. Several species of American trees, such as the red-oak and locust, appear to do better in Western Europe than in their native land, while *Salix amygdalina* and *Salix viminalis* the great European basket willows, which are grown in fields by the side of wheat and rye, fail in the Eastern United States because of the late summer drought.

Throughout a large part of Southern New Jersey, in those portions which are at a low-level and in which the water-table is close to the surface, there is usually a luxuriant growth of vegetation, although the soil may be coarse and sandy. Regions of a higher altitude, such as the Plains, suffer most from a lack of moisture and also from fire in consequence.

Throughout the Sand-lands of Northern Europe there is little variety in the nature of the forest. Wherever there is a clump

of woods on upland or lowland it consists of Scotch-pine. Sometimes it is in straight and thrifty condition, but mostly crooked and stunted in nature. There is lacking that variety which one meets with even in the Jersey pine regions, and while there exists a general resemblance between the two regions, closer examination soon shows that in reality they are very unlike. The soil, the climate, the flora, the political, social and economical conditions are all so different that it would be unfair to place the Jersey pine-lands in the same category with these immense tracts, of heath and morass which exist throughout Northern Europe.

We should not always assume, however, that because a soil is sandy vegetation will suffer from dryness more than on other soils. This depends altogether on the capillarity* of the soil and the proximity of the water-table to the surface. Owing to the cold and a great abundance of moisture peat accumulates in immense beds in Northern Europe. Just to the west of the Ems is the Bourtauger Moor, over five hundred square miles in area, on the boundary between Holland and Germany. Here and there in this morass are firm patches on which the houses of the natives are located, but the most of it is a quaking, treacherous mass of semi-decomposed vegetable matter. The inhabitants crossed this bog-land with leaping-poles. A board was attached to the end of each pole and both people and horses wore wooden "mud-shoes," such as are used on the oyster-beds of France and on the salt marshes of New Jersey. These moors were often so extensive that they served to separate tribes.

The surface of these moorlands was burnt at certain times of the year in order to render them fit for cultivation. The peat-smoke or "moor-rauch," in May, 1857, drifted as far as Vienna, and in July, 1863, to Geneva. In recent times more economical methods have been practiced, and canals have been dug for both drainage and transportation purposes. Wherever the land is imperfectly drained in this region, immense masses of "torf" or

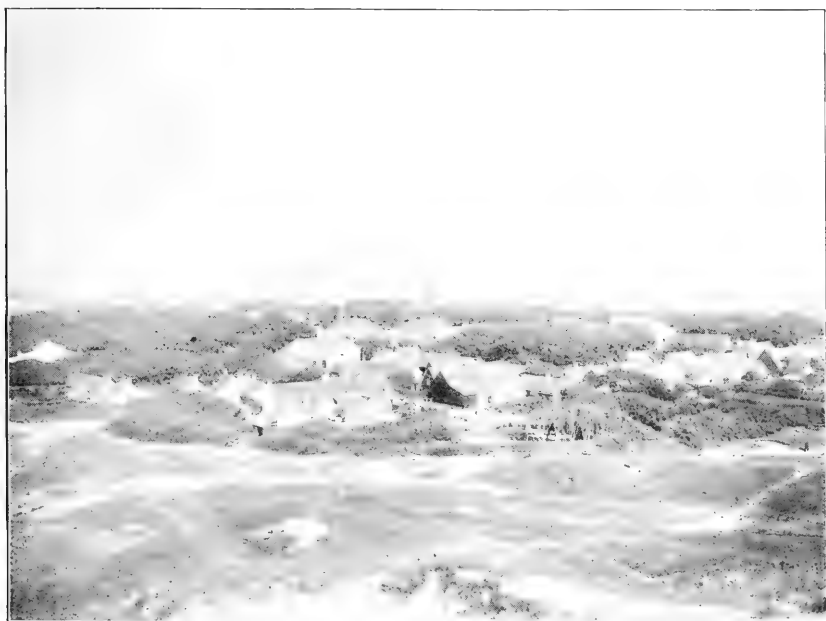
* In the sand-hills of Nebraska and Kansas, even after long periods of drought, only the few inches of surface-soil become dry. A short distance under the surface the soil is moist to the touch.

"In the dunes of Algeria water is so abundant that wells are constantly dug in them at high points on their surface. They are sunk at a depth of three or four meters only, and the water rises in them to a height of a meter."—Laurent, *Memoire sur le Sahara*. "The Dunes of the Sahara in some places supply pasturage for the caravans."—Pomel, *L'Annee Geographique*.

The city of Amsterdam is supplied with water from the Coast Dunes of Holland. This is simply rainwater, which soaks into the sand. The Hague also is similarly supplied.

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Plate No. XXX.



DOMBERG—A RESORT IN THE LEE OF THE ZEELAND DUNES



A PIECE OF RECLAIMED MARSHLAND IN ZEELAND



peat accumulate. Here and there are dune-like formations on which the Scotch-pine has been planted.

The Scotch-pine is a wonderful tree in respect to its endurance. It grows in the wet cold bogs and on the dry upland. Because of the remarkable endurance of this tree it has been planted in our arid West. The plantations are still young, but in a thrifty and promising condition.

Large portions of the heathland of Northwestern Europe is called "geest," which is high and dry, sandy or gravelly land. The geest which I have seen is gravelly, compact, and covered with a sparse growth of heathplants, and in appearance even more bare and sterile than the Plains of South Jersey. In general appearance it is not unlike the Plains, and I have no doubt but that trees would grow in this region were we to apply the same principles of culture which are applied on the geest lands of Holland and Germany.

The heathlands of Europe have been subjected in times past, and even in places to-day, to all sorts of abusive practices. They have been pastured, or better, overpastured, from time immemorial, and the top-soil has been many times removed by the peasants for litter, as in the Belgian Campine.

The best example of reclamation may be seen at Schovenhorst, near Putten, in Holland, on the Schober estate.* I was most cordially received by Mr. Schober, and he explained how that by thoroughly loosening the soil by deep plowing or spading and then applying the proper kind of fertilizer the abuse of years could be overcome and pine forests once more established, as was evidenced by the beautiful groves consisting of many exotic and native conifers which formed an oasis in the midst of a desert. There are conifers from almost every corner of the earth in healthy condition, forming one of the most remarkable botanic gardens I have ever seen, demonstrating well what may be done by perseverance and skill even where nature is stingy with her gifts.

Perhaps the largest and wildest of these heathlands is the Lüneburger Heath.† It is near the city of Hamburg, south of the Elbe, in the province of Hanover. The general surface is

* See "Pinetum Schoberianum," by G. A. Kuyk. Reprint from *Tydschrift voor Tuinbouw*.

† See *Kultur der Haideflächen*. Salfeld.

undulating, but the northern edge sinks down abruptly so that when viewed from afar it resembles a range of low hills. This is a part of the great North German Plain, which extends from the Ural mountains to the coast, consisting mainly of heath and moor, planted in places with Scotch-pine. It consists of loam, sand, clay, gravel and marl. Here and there are erratic boulders which have been deposited, no doubt, by glaciers. Where the soil is loamy and marly the beech is abundant. "The sand," says Salfeld, "forms scattered hills or great sandy plains from which the clay has been washed by the rains."

In many places the primeval forest consisted of oak and pine. In other regions beds of "ortstein," a sandstone similar to the "alios" of the Landes, prevents drainage and the growth of trees. On such places the heather holds full sway. These are natural steppes and probably have never been covered with trees.

In the Lüneburger Heath there are many small streams, although the region is at times quite dry and parched. The water quickly runs away and the region is exposed to the drying effects of the winds. "A trip across this heath in winter," says Salfeld, "is dreary enough." One meets here and there natives digging up the sods for litter. This exposes the soil to the wind so that it shifts more or less from place to place. Here and there are bee-stands which are used only in blossoming time when the keeper moves from place to place with his hives in search of fresh pastures. Here and there are sheep corrals. The shepherd even in winter may be seen alone with his flock of hardy, small black sheep called "snucken." As with the shepherds of the Landes he knits while his sheep crop the scanty herbage. These sheep live out of doors in winter, even in the snow, and when the lambs come many are killed by the shepherd, because one lamb must suck several mothers on account of the scarcity of food.

Here and there are streams with irrigated and fertilized meadows. Along their banks are alders and on the ridges of sand fringing the meadows are strips of pine to break the force of the wind.

At last we reach a farm. Attached to the straw-thatched house is a yard surrounded by a granite wall. Granite seems out of place here. The origin of the granite boulders from

which the walls are made is not, I believe, positively known. The cattle stand knee-deep in a mass of heath-litter and dung. In order to supply this litter an area at least five times the area of the cultivated fields is robbed of its cover. The removal of marl and turf and continuous cropping without rotation have produced a degree of poverty which is often pitiful.

The heath, in fact, is the land of the "little man," that is, the man of small pursuits. Birch and heath twigs are converted into brooms and brushes. Berries are sent to Bremen and Hamburg and are used in the manufacture of wine. Edible mushrooms are assiduously collected and juniper berries are picked for the manufacture of gin. Even the fine roots of the pine are woven into baskets.

According to Salfeld old chronicles and documents give assurance that the geest lands of Northwest Germany were once richly wooded. There are instances of remnants of old and extensive forests. "The extent of the forest was measured," says Salfeld, "by the length of time a squirrel could pass through it by leaping from tree to tree." These forests were of deciduous trees. They have been supplanted by the pine, owing to the gradual impoverishment of the soil. Storms, fire and insects played havoc in these coniferous woods, and swineherds and shepherds wandered at will with their flocks. There was great eagerness to clear the land for fields and meadows. The end has been reached, and now begins the long, tedious and expensive work of reforestation, which is the only salvation for abused and depleted sand-lands.

All this illustrates well the fact that unless the forest plays a part in the rotation of crops on sandy land it is only a question of time before the soil becomes absolutely sterile.

This land is being reclaimed first by deep ploughing,* which thoroughly loosens the soil and brings the richer subsoil to the surface.

The second step is in planting a leguminous crop for green manure. For this purpose the yellow lupine, what is called in Brandenburg "the gold of the desert" is used. This does not

* The work of reclaiming the Lüneburger Heath did not begin in earnest until 1870. It will be many years before the plantations will become remunerative. The growth is slow and the cost of reclamation high. Of late years steam ploughs have been extensively used in order to thoroughly loosen the soil.

grow in America, but we have many others which will answer the same purpose.*

The third step is the planting of pines.

The fourth step, and the ideal stage, as far as the fertility of the soil is concerned, is the production of a rich, dense forest of the broad-leaved trees, such as the Forest of Compiègne, which is pictured in the frontispiece of this report.

Forestry in Denmark.

Nowhere in Europe is forestry more intensively developed than in Denmark. These practical people waste no time in advertising what they have accomplished. They have been working more for financial gain than for glory. There is a commendable lack of sophistry and impractical notions in reference to their forest management. It is not my intention to attempt to describe their methods in this connection, but no place is more worthy a visit by American foresters. For many years these enterprising people have been at work developing a system of their own. They have been practically unnoticed by foresters until recently, when their methods were described by Dr. Metzger, in the *Mündner Hefte*. Several writers on the continent are endeavoring to show that the Danish system is after all old, and has been elsewhere in practice more or less for some time. Even if this may be so, the Danes were the first to fully appreciate its advantages and put it into execution. They have been quietly "sawing wood" while their neighbors have been holding learned discussions. The Danish foresters long ago traveled throughout Europe, absorbed what they needed and evolved from it a system of their own, adapted to the peculiar conditions of their little country. They were particularly influenced by what they saw on some private estates in England. They show, indeed, the same amount of intelligence in everything they attempt. Their dairy industry is a model, every man and woman can read and write, and every traveler to their

* The sandy soils of the Pines are in need of humus and green manuring. For this purpose there is no better crop than *Lupinus perennis* which will grow where other leguminous crops fail. The plants of this genus were named *lupinus* from *Lupus*, a wolf, because it was thought that they devoured the fertility of the soil. Nothing could be farther from the truth. The *perennial lupine* of Southern New Jersey is one of those pioneer plants which in the midst of the sand is paving the way for less hardy species.

country is impressed with the fact that they are an honest, solid, wide-awake, up-to-date people.

The forests of Denmark are of special interest to Americans because a large percentage of the forest is owned by private parties. The excellent system of forest management is the result of private enterprise. Only six per cent. of the country is wooded. These woods are mostly on the islands. Jutland is mainly heathland. The soil of the country is sandy. A calm day is rare, and without eternal vigilance and care a large part of the country would blow or wash into the sea.

The production of Danish forests is high. They produce 4.8 cubic meters of wood per year per hectare. The highest yield in Germany is in Erfurt, which is 4.5 cubic meters.

The ease of importing both coal and wood cause great competition. Denmark is near to Norway and Sweden, which are great exporters of wood, and near to England, a great exporter of coal. Sixty per cent. of the Danish forests are beech, which is used for fuel, butter-tubs and wooden shoes; seven per cent. is oak, which is used for ship building, and twenty-one per cent. conifers. The Danes have outgrown the notion that conifers are preferable to hardwoods. Even the forestation of heathlands with conifers is regarded a necessary evil, and they cherish the hope that some day the soil will be fit for hardwoods.

The wood is sold direct to the purchaser without auction, and the foresters are more on the order of enterprising business men than mere administrative officers who spend most of their time at the desk writing reports. The position of chief forester in Denmark requires a knowledge of commercial principles and business skill. These men are granted much freedom and confidence by their employers. They receive a share of the profits and are therefore financially interested in every operation.

There is no great secret to their methods. It is simply the application of great skill and economy. They simply do what pays the best; that is, employ those principles of business management which produce the largest returns in the shortest length of time, preserving at the same time a sustained yield and desirable soil conditions.

The Danes are great believers in pure stands, and instead of producing 500 spindling oaks on a hectare of land, are content with 200 sturdy, well-crowned specimens, because it pays.

Great attention is paid to the soil. Their aim is to keep the surface covered with a coating of damp, mellow leaf-mold. They are the friends of the earthworm, and do everything possible to encourage this assiduous little animal, which does good work in keeping the soil loose and mellow.*

Very careful protective measures are necessary throughout Jutland, because of the winds. Wind-breaks of trees and shrubs, and turfed earthbanks are necessary, otherwise the winds would shift the soil from place to place.

Metzger describes a beech forest 300 meters from the sea. The outer edge consisted of an impenetrable hedge of clipped beech, ten meters in width. The soil was full of earthworms.

No peasant rights or onerous servitudes exist in Denmark. The Danish foresters do not combine hunting with their profession. They carry a spade rather than a gun. In short they are the Yankees of Europe, from whom we can learn many things.†

* The importance of soil aeration is often overlooked by foresters and soil cultivators. When a large forest fauna is present, especially earthworms, the soil is kept mellow and sweet, and hardpan and peat are less apt to form. When there is an abundance of these animals in the soil, it is usually an indication that the soil is in good condition.

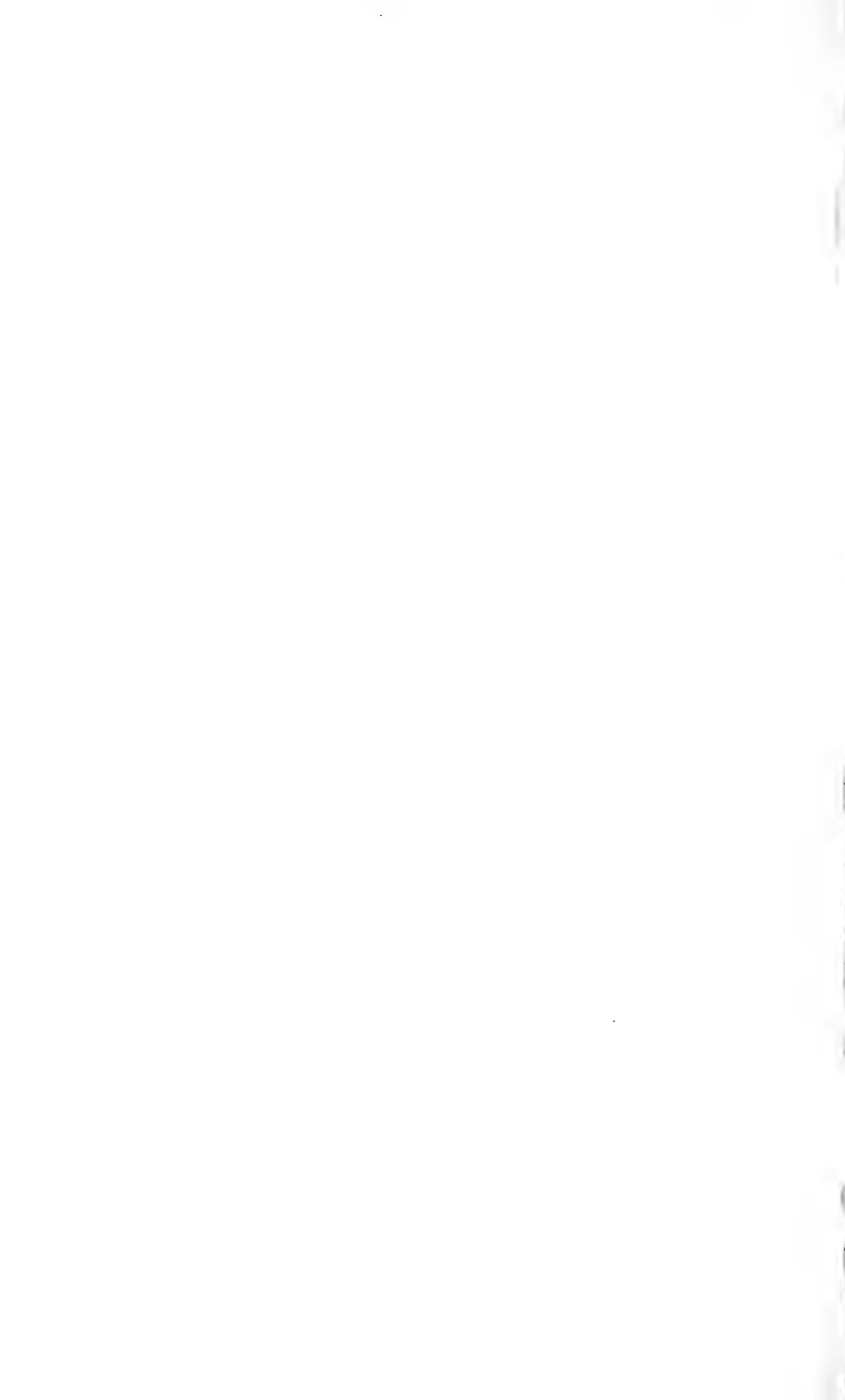
† In the use of scientific names of trees in the above I have been guided by the "Check-list of the Forest Trees of the United States," by George B. Sudworth, Division of Forestry, Dept. of Agriculture, Washington, D. C.

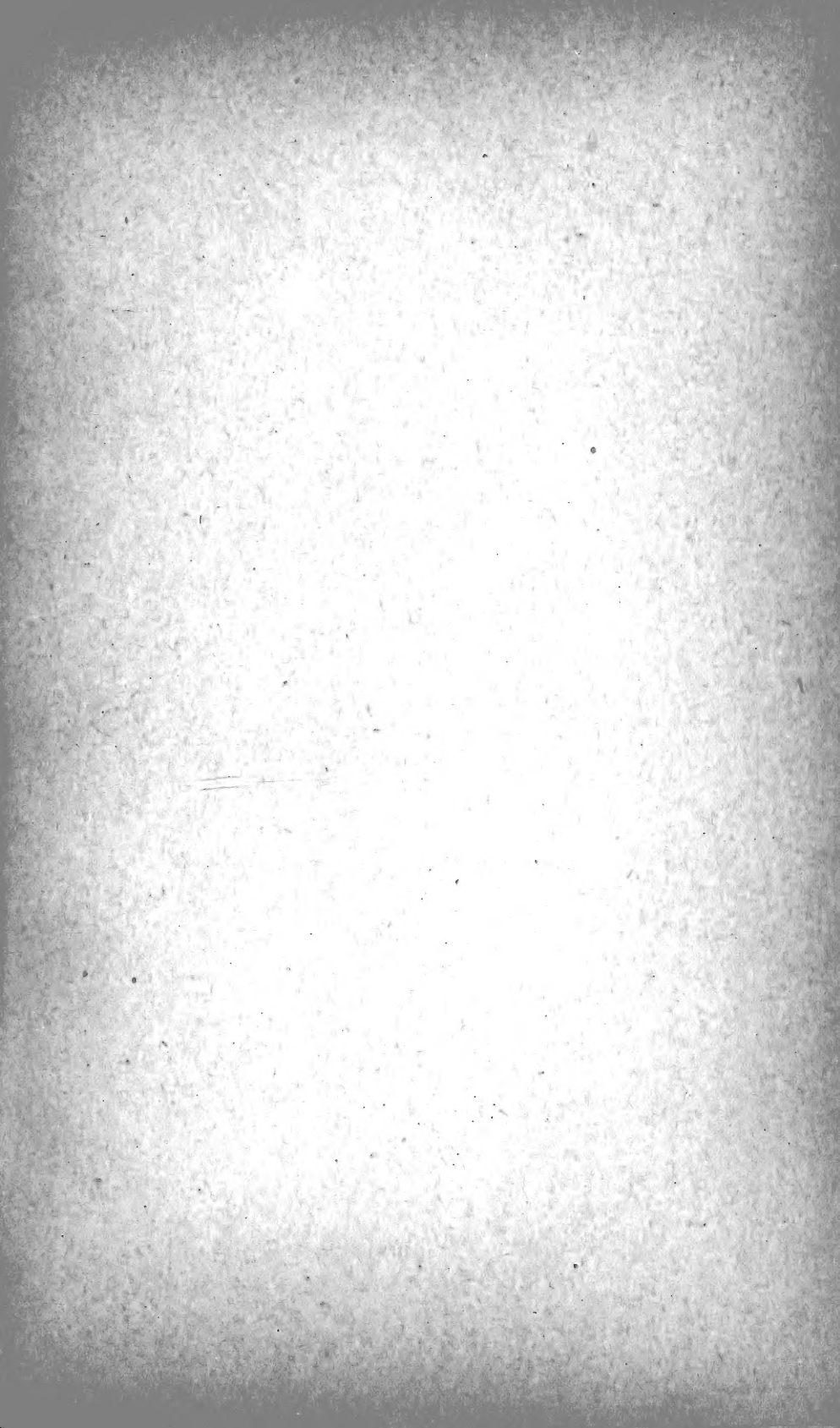
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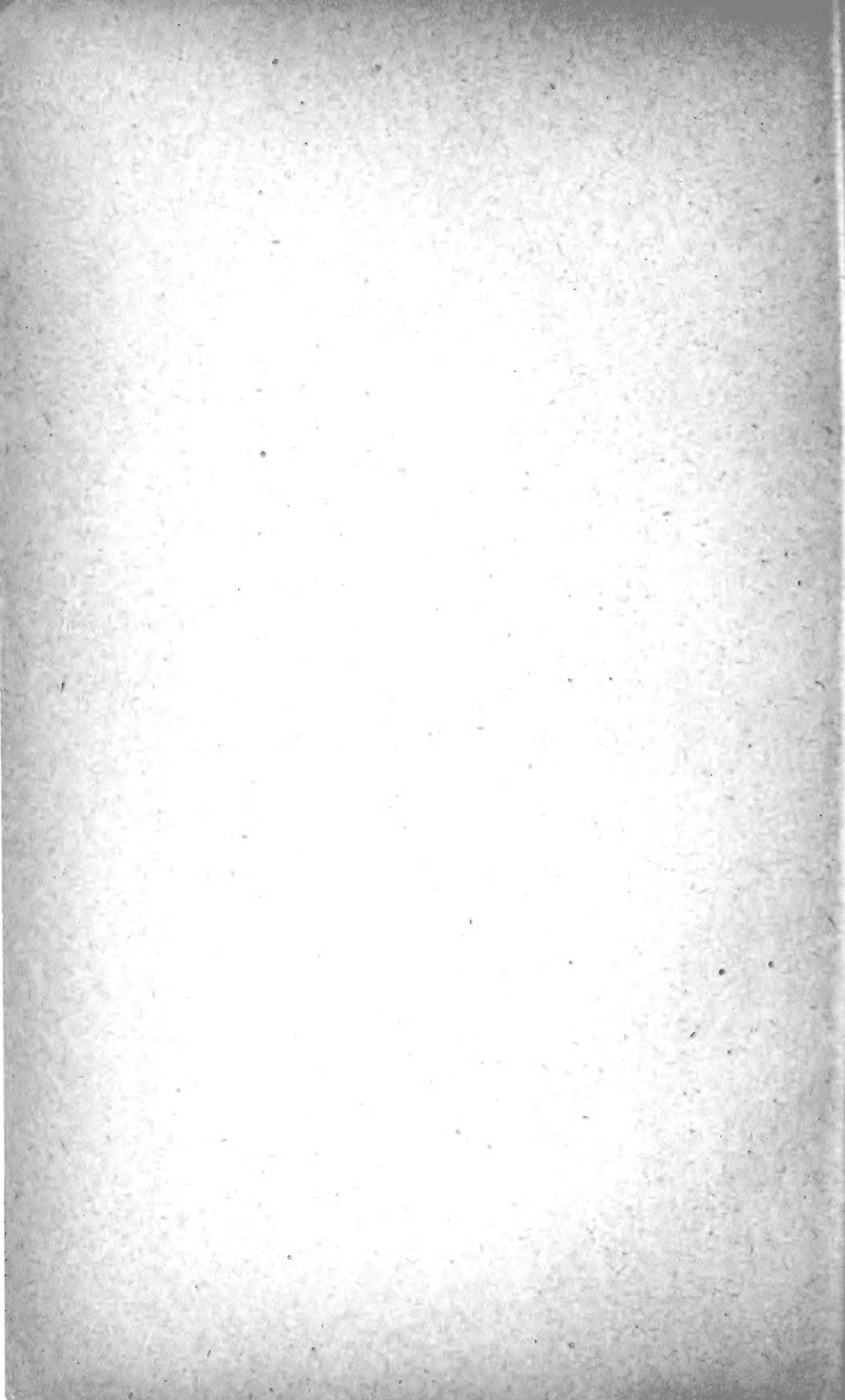
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