A HISTORY OF THE FORESTS OF CAPE COD

by

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FOREWORD

The writer is indebted to A. C. Cline, now Director of Harvard Forest, for his role in the initiation of this study, and for his encouragement, criticism and material contribution in providing stenographic assistance. The writer is also indebted to most of the librarians of the towns of Cape Cod and to Miss Helen B. Shattuck, librarian of the University of Vermont and her assistants, for many courtesies; also to the memory and interest of George P. Morse, Wareham, Massachusetts, and to a score of friends and acquaintances on Cape Cod for information and assistance.

PART I

PURPOSE OF THE STUDY

If one is to understand fully the extent of any natural process, he must first know something of its beginnings. The process of the forest deterioration on Cape Cod* has covered so great a period of time that it is now surrounded by a haze of conjecture and opinion. The present study has had as its purpose a clearing of the historical background, in order to determine not only the extent of the vegetational changes which have occurred as a result of the influence of man, but the nature of the phenomena which have brought about these changes. It is the hope of the writer that this information not only will stimulate and facilitate a coordinated program of biological research within the area under discussion, but that it may help to destroy that apathy toward destruction of a resource which breeds upon a lack of understanding both of the motivation behind social action and the effect of the loss of such a resource upon the entire citizenry.

METHOD

No one of the early journalists of Cape Cod has left us with a really satisfactory description of the forests of this area as they existed prior to settlement by the Pilgrims. Moreover, there may be found in the writings of later diarists and historians only brief and often indirect mention of the land, its resources, and their utilization. From the beginning of the eighteenth century

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* The term "Cape Cod", as used in the present paper, refers not only to Barnstable County, Mass., but to that portion of southeastern Plymouth County, Mass. which is included in the original (1894) Plymouth Quadrangle of the U. S. Geological Survey series. The common geological and historical backgrounds of these areas make them an ecological unit.

until the middle of the nineteenth, Cape Cod--and in particular Barnstable County--might almost have been described as a huge home port for ships; a place where men of the sea kept their families. Most of the industries that operated upon the land were auxiliary to the activities of men who drew upon the resources of the sea, or of the lands beyond the sea. The sea dominated the thoughts of these people, and of their later historians. Finally, many of the older records of Cape Cod have been lost through fire.

Because of the nature of the circumstances, the method used by the writer has of necessity been somewhat analogous to that of the anthropologist who, finding a few bones, reconstructs out of clay a prehistoric creature. The line of reasoning behind major reconstructions of this sort will be found in the text.

The almost insular nature of Barnstable County has enabled the writer to draw much information relative to the forest indirectly from other activities of its people. The same method could not be used so successfully for the Plymouth area of Cape Cod, because of the greater influence of adjoining lands, and because its boundries are of an arbitrary rather than a political nature. Treatment of the latter area must, therefore, be somewhat less complete than that of Barnstable County.

PHYSIOGRAPHY OF THE AREA

A casual observer on Cape Cod easily becomes "sand conscious". Because of this fact, there has been a popular tendency to over-simplify both the geological and the vegetative history of the area. A brief review of the more important physiographic features of Cape Cod seems therefore to be desirable*.

Cape Cod rests upon a series of sand, gravel and clay beds dating back to Tertiary time and laid down in the usual manner upon the bed of the ocean. Shaler (1897) has concluded that these Tertiary deposits rise to considerable height above sea level from Buzzards Bay eastward through the towns of Bourne, Sandwich, Falmouth and Mashpe.

Over the finer depositions of Tertiary and early Quaternary time a great mass of glacial debris was later deposited. These deposits were many, and the materials dropped varied greatly in texture. In general, however, the clay content diminished in the more recent depositions in favor of sand, gravel and a scattering of boulders.

Erosion since glacial time has proceeded in very uneven fashion over the surface of Cape Cod, so that the materials exposed today represent a very broad cross-section with respect both to texture and to time of deposition. Latimer, Mexon and Smith (1924) called attention to the presence of heavier soil materials in their statement, "In nearly all areas (of Barnstable County) the surface soils are slightly heavier in texture than the subsoils....the only exception to this is found in the southern part of Barnstable County,

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* For further information on the geography and geology of Cape Cod, see Shaler (1897) and Woodworth and Wigglesworth (1934).

where a heavy layer of stratified sediments comes near enough to the surface to form the subsoil". Brick works have operated over a period of time in Sandwich, deriving their materials from the clay layer that outcrops along the north base of the Barnstable Moraine, mentioned below.

Several features mark the present surface area of Cape Cod. Five miles southeast of the town of Plymouth, Manomet Hill, rising to a height of 350 feet, forms the north end of a long ridge that extends in broken fashion directly south to Cape Cod Canal, then continues uninterruptedly to the village of Woods Hole, and out to sea in a curved line to form the Elizabeth Islands. Shaler calls this ridge the Plymouth Moraine.

At Bourne another such ridge, known as the Barnstable Moraine, breaks off at a right angle and follows the curved line of the north shore eastward to the sea at Orleans.

In the Plymouth area, extending across the north end of Myles Standish State Forest, is still a third and unnamed height of land.

All of these high points are notable for the coarseness of their surface materials, great boulders being of frequent occurrence (See Fig. 7).

A second feature of the surface of Cape Cod is the presence of a great number of lakes, ponds and dry depressions, many of which have the appearance of huge, irregular pot holes. Most of these surface depressions occur in a hit or miss fashion across the landscape, but a great number of them are members of a series of chains, each of which upon close study is seen to follow the course of an ancient valley. The levels of the ponds vary relatively little, though they drop gradually as the sea is approached. Depressions whose bases are more than 100 feet above sea level in

the Plymouth area, and 60 feet in Barnstable County, are usually dry, thus indicating the absence of heavy soil materials above these elevations.

This absence of heavy soil materials results also in a scarcity surface drainage on lands whose elevation is above 60 to 100 feet. This in a country of approximately 45 inches of rainfall!

Most of the Provincetown fist, and large areas in Barnstable County along the rims of Cape Cod Bay and Nantucket Sound are composed of materials deposited by ocean currents and winds during recent postglacial time. This material is a very uniform, coarse, and sterile sand.

PART II

THE "ORIGINAL" FORESTS OF CAPE COD

While none of the diaries and records of early explorers and settlers has contained an entirely satisfactory description of the early forests of Cape Cod, these writings do contain invaluable clues, which permit a considerable amount of interpretation. When these records have been consolidated and carefully interpreted, one is left with a reasonably accurate picture of these forests at the time of the Pilgrim landing.

Provincetown Harbor was known to men of the sea long before the Pilgrims came to its shore. Early explorers of the North Atlantic Coast who sought respite from the violent storms of the area, or who were caught in the cul-de-sac which is Cape Cod Bay, were unable to avoid close acquaintance with it. Early descriptions and references to "Cape Cod" refer in particular to the wind-swept fist of land surrounding Provincetown Harbor, a land in the process of creation out of the depositions of off-shore currents and the action of winds.

We can understand, therefore, Captain John Smith's (1616) dismissal of "Cape Cod" as "only a headland of high hills of sand overgrown with shrubby pines, hurts, and such trash, but an excellent harbor for all weathers". Champlain was even briefer. He wrote, "which we named Cape Blanc because they were sands and dunes which appeared thus".

But how can we explain the following description, contained in that early Pilgrim diary known as "Mourts Relation" (Bradford and Winslow)? At the time of the landing of the Pilgrims at Provincetown these authors wrote, "The ground or earth, sandhills,

much like the downs of Holland, but much better; the crust of the earth, a spits (spade) depth, excellent black earth; all wooded with oaks, pines, sassafras, juniper (Chamaecyparis), birch, holly, vines, some ash, walnut (Hicoria). The wood for the most part open and without underwood; fit either to go, or ride in".

The qualification "for the most part" was carefully considered, since a bit later in their journal the authors tell of struggles with "boughes and bushes" which "tore our very armour to pieces".

When this group landed at Plymouth, these same journalists described the vegetation of that spot in almost identical language. They changed their list of trees only to the extent of adding beech.

Another reference to the early vegetation of the outer Cape area is found in Archer's (1602) account of Gosnold's Settlement at Cuttyhunk. Gosnold made a temporary landing in the neighborhood of Nauset Harbor, in the town of Eastham. Archer wrote: "The Captain went ashore and found the ground to be full of pease, strawberries, whortleberries....the firewood there by us taken was cypress (Chamaecyparis), birch, witch hazel, and beech...."

A close scrutiny of these and other early records forces one to conclude that all of these records are accurate in a limited, rather than in a general sense. The record of the wanderings of the early Pilgrim exploring party ("Mourt's Relation") indicates clearly a wide variety of vegetative cover.

Henry David Thoreau (1886), an outstanding student of plant life, after careful observation of conditions in the towns of Truro and Provincetown, in 1850, had the following comment to make with respect to the description of the original forest which is quoted from "Mourt's Relation", above: "Notwithstanding the great

changes which have taken place in these respects, I cannot but think that we must make some allowances for the greenness of the Pilgrims in these matters which caused them to see green. We do not believe that the trees were large or the soil was deep here. They naturally exaggerated the fairness and attractiveness of the land for they were glad to get to any land at all after that anxious voyage. Everything appeared to them of the color of the roses, and had the scent of juniper and sassafras....

"When the Pilgrims got to Plymouth, their reporter says again, 'The land for the crust of the earth is a spit's depth'--that would seem to be their recipe for an earth's crust--'excellent black mould and fat in some places'. However, according to Bradford himself, when some consider the author of part of "Mourt's Relation", they who came over in the Fortune the next year were somewhat daunted when they came into the harbor of Cape Cod and there saw nothing but a naked and barren place. They soon found out their mistake with respect to the goodness of the Plymouth soil".

A key to the solution of the controversy which has been aroused by these statements has been furnished by Thomas Morton (1637). Morton was a trader, an opportunist who accepted the world as he found it, who ranged widely and was able to mix freely with the Indians because he accepted without prejudice their manner and customs, and because he used as barter the articles in greatest demand by the Indians, namely, guns, bullets and, where necessary, liquor.

Morton has given us a series of word pictures of these Indians and their customs that are a priceless contribution to the early literature of southeastern Massachusetts. In the following statement, he makes the greatest single contribution of any early writer

to the clarification of the "original" forest conditions on Cape Cod: "The Savages are accustomed to set fire of the country in all places where they come; and to burn it twize a yeare, vize, at the Spring, and at the fall of the leafe. The reason that moves them to do so, is because it would be otherwise so overgrown with underweedes that it would be all a copice wood, and the people could not be able in any wise to passe thru the country out of a beaten path,...The burning of the grasse destroys the underwoods, and so scorcheth the elder trees that it shrinks them, and hinders their growth very much: So that hee that will look to find large trees, and good tymber, must not depend upon the help of a wooden prospect to find them on the upland ground, but must seek for them...in the lower grounds where the grounds are wett when the country is fired...For when the fire is once kindled, it dilates and spreads itself against as with the winde; burning continually night and day, until a shower of rain falls to quench it. And this custom of firing the country is the means to make it passable, and by that means the trees grow here and there in our parks."

Dwight (1821) has explained that "The grounds, which were covered with oak, chestnut, etc., or with pitch pines, were selected for this purpose, because they alone were, in ordinary years, sufficiently dry". The purpose of this burning was not merely to make the country more passable, but doubtlessly to produce an ever new and tender growth of hardwood sprouts, and to prevent the shading out of grass, in order to maintain the food supply of deer, as several writers including Dwight have pointed out. Forest destruction was not necessary for this purpose. The burning operation was carried out by the Indians in early spring and late

fall and, in so far as possible, against the wind, in order to prevent such a catastrophy.

These contributions, therefore, leave little room for controversy, in so far as the general picture is concerned. Other references made later in the present paper will tend to corroborate the descriptions which follow immediately.

On the elevations above 100 feet (note Morton's reference to a "wooden prospect") there was revealed to the Pilgrim group an expanse of open park-like forest, the floor of which was fairly well carpeted with coarse grasses. Much of this forest was almost pure pitch pine (Pinus rigida, Mill), although between one hundred and two hundred feet elevation were numerous stands of nearly pure oak*. Frequent burning prevented the development of shrubby vegetation. On the floor of the pitch pine stands, in particular, these shrubs** awaited only a neglect of annual burning to become a real detriment to travel (Morton, 1637).

As the early explorer dropped down to approximately 100 feet elevation above sea level, red oak (Quercus rubra, L.) and beech (Fagus americana, Sweet) appeared in the stand, and white and chestnut oaks, and red maple became more numerous. White pine also became an important factor in the stand. Pitch pine was still present in stands of this character. Trees of all species were taller and of better form than those found on the higher elevations. These stands were subject to frequent burning, but fires were less

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* Major tree species: (Quercus coccinea, Muench.), Q. velutina, Lam., Q. alba, L., Q. Prinus., L.)

Minor tree species: Red maple (Acer rubrum, L.), gray birch (Betula populifolia, Marsh.), white pine (Pinus strobus, L.).

** Most important elements: Heaths (Vaccinium spp., Gaylussacia spp., Arctostaphylos Uva-ursi, L.); laurel (Kalmia angustifolia, L.); Juneberry (Amelanchier spp.); and scrub oak (Quercus nigra, Marsh. and Q. marilandica, Muench.).

intense than in stands on higher sites, because heavier foliage and somewhat finer soils resulted in a cooler, moister forest floor. Less grass, but more small shrubs and vines, were present in the understory. It is possible that grape (Vitis spp.), the abundance of which is frequently mentioned by early explorers, began to appear at this elevation; also green briar (Smilax spp.).

At a level of approximately 75 feet, hundreds of ponds and lakes may be found throughout Cape Cod. Springs and small streams also make their appearance. The effect of heavier soils and a shallower water table upon the forest cover was very noticeable to the early explorer. Forests below this elevation* were protected from fire not only by a moister forest floor, but by physiographic features such as lakes, ponds, swamps, streams and deeply indented arms of the ocean. Here was found the mesophytic association mentioned by Bradford and Winslow, and by Archer (1602) (Note Figs. 8 and 9). A mixture of white pine, pitch pine, hemlock (Tsuga canadensis (L). Carr.), beech, yellow birch (Betula lutea, Michx.), ash (Fraxinus spp.), hickory (Hicoria spp.), red maple, white and red oak, sour gum (Nyssa sylvatica Marsh.) and holly (Ilex opaca, Ait.) made up the dominant tree association, except on sites with a definitely south exposure. The latter sites were occupied by those species within the above group that were capable of withstanding somewhat drier and warmer conditions, namely, white, black and scarlet oak, white and pitch pine, and possibly beech.

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* On the newer lands, such as the Provincetown fist, Sandy Neck and Monomoy Point, the water table remained close to ocean level, with the result that xerophilous vegetation was found at a correspondingly low level. A similar situation existed on the Nauset Plains, north of Eastham Village, where a variation in geological history (Shaler, 1897) had resulted in the presence of a lower level of sand and gravel materials.

The great bogs of Cape Cod were occupied by a luxuriant growth of coast white cedar (Chamaecyparis thyoides (L.) BSP) in the early seventeenth century. Areas close to tide-water, whose character was more in the nature of a swamp, were occupied by a thick growth of shrubs (Bradford and Winslow) and (Thoreau, 1936).

A variation in the above distribution of vegetation was created by the agricultural practices of the red men who had dwelt in this area from time immemorial. Since corn and certain other crops were cultivated by these people, clearings were necessary. Many of these clearings were very large in size. One, whose area is described as fifty acres, was found by an exploring party in the present town of Truro. Another, whose length was five miles, was found by John Goodman and Peter Bourne when they had become lost in the woods behind Plymouth village (Bradford and Winslow).

In general, these clearings were located close to the ocean, or to streams, since proximity to the water table and to a supply of fish (largely alewives) or crabs for fertilizer was necessary. The work of clearing this land was slow and laborious, due to the primitive nature of the tools used by the aborigines. Trees were usually felled by fire, after they had been killed by girdling. Soils were cultivated until their fertility waned, after which they were permitted to lie fallow, or even to become reforested. Current observations indicate that the most common "old field" tree species was pitch pine.

After considering a variety of factors, the most important of which are geology, geography, climate and aboriginal practices, the writer has attempted to summarize forest conditions as they existed in 1620 (Table 1).

TABLE 1

Summary of Land Classes on Cape Cod at Time of Landing of the Pilgrims

Land Class	Barnstable County	Plymouth Area	Total Acreage
	Per Cent of Land Surface	Per Cent of Land Surface	
1. Open corn lands	1.5	3.0	6,700
2. Pine forest - abandoned corn lands	2.0	5.0	10,000
3. Forest area affected by burning	61.0	74.0	222,800
4. Mesophytic forest association	32.0	16.0	94,000
5. Coast white cedar	1.0	3.5	6,000
6. Swamp and sand waste	1.5	.5	4,200
Total	100.0	100.0	
Total Land Area - in Acres	243,670	100,000	343,700

According to the author's estimate, which admittedly is based on insufficient data to be considered more than a rough approximation, there was present on Cape Cod at the time of the Pilgrim landing, about 330,000 acres of timber of saw-log size, that is, timber ranging in diameter from about 10 to 50 inches. Approximately 94,000 acres of this cover was of the type known in New England as transition forest, answering closely to the descriptions found in the early Pilgrim journals. About 6,000 acres of land were occupied by pure stands of coast white cedar, while approximately 230,000 acres of land were occupied by stands of timber that varied from pure pitch pine or mixed oak, on the higher elevations, to mixtures of trees that approached the transition type, on the intermediate elevations. A relatively small area

(less than 10,000 acres) is estimated by the author to have fallen within the three categories: waste land, agricultural land, and forests whose trees averaged less than 10 inches in diameter.

CAPE COD FORESTS OF TODAY

In the years 1917 and 1927, data were assembled by the staff of the Massachusetts' State Forester (1917 and MS) on the forests of Plymouth and Barnstable Counties, respectively. The data were summarized by townships into a series of tables, but unfortunately forest classifications were not plotted upon maps. These data present in a fairly satisfactory manner, however, a general picture of the forests and other types of land use on Cape Cod at these dates.

In presenting these data, the writer has been forced to take some liberties in order to make the classifications for the Plymouth area and Barnstable County as comparable as possible. Certain values have been expressed in per cent of area rather than in acres, in order to facilitate comparisons and contrasts. A summary of these data is contained in Table 2 below*. Detailed data for the various townships of Barnstable County may be found in Appendix "A".**

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* Due to the fact that the Plymouth Quadrangle includes not only the township of Plymouth, but also portions of three other townships of Plymouth County, the data for the township of Plymouth, expressed in percentage of the total land area, is used as representative of the entire portion of the quadrangle which lies within Plymouth County.

** There are discrepancies in certain estimates of area between the data contained in these reports and those contained in the U.S. Census for a nearly identical period. Because the reports of the Mass. State Forester contain detailed information with respect to forest conditions that are not found in U.S. Census reports, figures from these reports must be used in Table 2 and Appendix "A". Because U.S. Census reports reveal changes in general land use over a broad period, data with respect to land use found in later sections of this study will be taken exclusively from Census reports. This unavoidable discrepancy does not greatly affect the picture of current forest conditions, however.

Although it is obviously impossible to assemble data for the two periods, 1620 and 1920, on an identical basis, Tables 1 and 2 do provide a fairly satisfactory means of measuring the changes which have been brought about as the result of 300 years of the stewardship of white men.

Consideration of the problems created by these changes will be found in later sections of this study.

According to Table 2, there existed on Cape Cod in 1920 an insignificant acreage of forest containing timber of saw-log size. And most of the timber of saw-log size was not of saw-log quality. The oak was gnarled and badly damaged by gypsy moth and by disease. It was almost entirely of sprout origin. The pitch pine was rarely straight enough to permit utilization of more than short logs. The quality of the white pine was low. Much of this also had been damaged by attacks of the gypsy moth. Red ring rot was a common defect in white pine.

There did remain, in the 1930's, a large additional area of land which has been classified as forest; 236,160 acres, to be exact. Of this area, more than 182,000 acres were covered with growth that was less than 2 inches in diameter. Of the woody species comprising this growth, pitch pine and scrub oak were most important. Except for the areas of old field pitch pine in Barnstable County, most of this pitch pine consisted of struggling, fire-scarred sprouts (See Fig. 1) that gave little promise of anything more than a mere cover for the land. Very little of the old field pitch pine, in fact, showed markedly greater promise, since it was growing on soils whose small store of fertility had been destroyed by primitive agricultural practices.

Table 2

LAND CLASSIFICATION DATA

A. Plymouth Area - 1917

Per Cent of Total Area, Exclusive of Fresh Water Surface and Tidewater Marsh

Tree Size D.B.H. Inches	White Pine Land	White Pine and Oak Land	Oak Land	Pitch Pine and Scrub Oak Land	Agricultural Land	Residential Land	Idle Land	Total Per Cent	Total Acreage
					9.7	2.8	.3	12.8	13,000
Less than 2	-	3.3	6.3*	43.9				53.5	53,500
2 - 7	.5	4.0	9.0	12.6				26.1	26,000
8 - 10	.1	.6	2.2	2.2				5.1	5,000
10 or more	.3	.7	.4	1.1				2.5	2,500
Totals	.9	8.6	17.9	59.8	9.7	2.8	.3	100.0	100,000

B. Barnstable County - 1927

Tree Size D.B.H. Inches	Scrub Oak Land	Pitch Pine and Oak** Land	Oak Land	Pitch Pine*** Land	Cedar Swamp	Agricultural Land	Residential Land	Idle Land	Shifting Sand Land	Total Per Cent	Total Acreage
						14.2	13.2	9.8	.6	37.8	92,000
Less than 2	12.0	9.0	14.2	17.7	-					52.9	129,000
2 - 7	-	2.4	2.2	4.6	.1					9.3	22,600
8 - 10	-	-	-	.1	.1					.1	60
Totals	12.0	11.4	16.4	22.4	.1	14.2	13.2	9.8	.6	100.0	243,660

* Includes pure scrub oak, and sprout areas of tree species recently cut, burned or killed by insects.

** Includes pitch pine and scrub oak; and pitch pine and arborescent oak.

*** Old field type.

Pitch pine not of old field origin is invariably mixed with scrub oak on Cape Cod, while beneath the latter is usually found a ground cover of heaths, sheep laurel, bearberry and other small xerophilous shrubs.

Table 2 also reveals the presence of approximately 49,000 acres of forest on which the trees ranged in diameter from 2 to 7 inches. Fig. 2 shows an average quality stand of old field pitch pine in this diameter range. Figs. 3 and 4 show stands of pure pitch pine not of old field origin, in this diameter range; while Fig. 6 shows a stand of mixed oak, the autumnal appearance of which is an illusion, since it has just been stripped of its foliage by the gypsy moth. In the white pine-oak mixtures, all trees have been attacked by the gypsy moth.

Finally, there are 5,900 acres of forest land upon which the timber averages 8 to 20 inches in diameter. Most of this is either pitch pine or oak. A small amount of white pine remains in the Plymouth area. White pine occurred in Barnstable County in amounts too small to record. Fig. 5 shows a stand of pitch pine in this size range, although conditions of undergrowth have been disturbed.

The picture of forest devastation on Cape Cod today is not a cheerful one to contemplate. Has this destruction of a natural resource been absolutely necessary? Is the current trend toward further destruction, or is progress now being made toward forest restoration? If the forces which have brought about this destruction still operate freely, can we determine, by a study of their operation, how they may be overcome? Do forest conditions on Cape Cod justify any great restorative effort today? If a restorative effort is found to be justified, what values are uppermost today in the determination of forest policy?

These are some of the questions which well up in the mind of the forester when such a dismal picture as the above is presented. It is as an effort to answer some or all of these questions that the history which follows has been written.

PART III

INFLUENCE OF THE WHITE MAN - SEVENTEENTH CENTURY

Land Cultivation

The ferment out of which the Pilgrim fathers stepped was a by-product of great social and industrial changes taking place in England at the turn of the Seventeenth Century. The flood of modern knowledge had begun and, even as today, purposeful individuals were able to profit by the confusion of society which resulted. The Pilgrims were village folk, one segment of a large population whose economic underpinning was being rudely struck away by the fencing into sheep runs of the lands that had been expropriated from the old baronage and the Catholic Church by a new landowning nobility, to meet the demands of a revolutionized, wool textile industry (Abbott, 1818) (Goldsmith. The Deserted Village). They differed greatly from many other groups that came to America about this time in that they had no illusions of easy wealth. They were of a class accustomed to labor, and asked only for soil and freedom to think as they wished.

The interest of the Pilgrim group in the land is strikingly revealed in the first ecstatic descriptions of the soil of Cape Cod by the authors of "Mourt's Relation". So little prepared, in fact, was the group to draw upon the resources of the sea that there were not even fishhooks among their first belongings. Until the beginning of the eighteenth century the principal energies of the Old Colony were devoted to agriculture.

The colony increased rapidly in population after the first difficult winter. In 1627 the tillable land was divided among the family groups present, 20 acres being assigned to each family, all remaining land being held in community ownership.

The influx of settlers which followed the changes of 1627 was very rapid, taxing the capacity of the land available for cultivation. For the Pilgrims very quickly discovered a harsh fact, namely, that when the shore lands, the Eel River Valley, and the land adjacent to Manomet Point (the Carver sandy loam of modern nomenclature) had been occupied, there was very little other land suitable for cultivation in the immediate vicinity of Plymouth Village.

The trend of settlement from this time on is shown by the recognition, about 1638, of the townships of Marshfield, Duxbury, Scituate, Taunton, Seacunke (Rehobeth), Yarmouth, Barnstable, Sandwich and Nausett (Eastham). By 1641 there were complaints about the "straitness and barrenness of ye place", which caused many to remove, and much talk of this by others. Attempts at cultivation of the sand country back of Plymouth had largely failed. The acreage in actual cultivation today in the Plymouth area is probably an all-time maximum, or very nearly that, due to the recent development of the cranberry industry.

Land cultivation attained a greater importance during the seventeenth century in Barnstable County than in the Plymouth area. Unfortunately for agriculture, the judgment of the band which left Plymouth in 1646 "for better parts" was poor. This group settled on the thin soils of Nausett (Eastham) plains and shortly thereafter began to encounter difficulties with that soil.

There is, of course, no accurate means of estimating the area under cultivation in Barnstable County before the federal census taking of the nineteenth century. One method of arriving at the area under cultivation during the seventeenth century is to divide the population by five to arrive at the number of families (since

early records show this to be the average family size), and then multiply by twenty, the acreage usually assigned to a family (Higgins, 1918). A shorter method is to multiply the population by four. The writer has, therefore, prepared a table of population for the towns of Barnstable County, the early figures of which are, with a few exceptions, purely estimates, based upon such indirect information as is available in the various towns. This table is contained in Appendix "B".

The value of the above procedure lies in the fact that it puts a reasonable limit upon speculation with regard to the extent of cultivation in the early days. When the resulting figure is compared to the total acreage in the area, one is able to visualize more clearly the relation of cultivation to the original forests of Cape Cod. Thus, in 1684, Eastham, with a known population of 650 was cultivating approximately 2900 out of a total of 45,000 acres, or 6% of its actual land surface. Barnstable County as a whole, on this basis, was cultivating about 21,000 out of a total of about 243,000 acres, or nearly 9% of its land surface. A slight additional acreage was, of course, cultivated by the Indian population.

The small store of fertility in the Eastham soils was rapidly depleted through cropping, leaching and surface erosion. The only fertilizer added to the soil was fish and crabs (Pratt, 1944). Wind hastened depletion on the exposed sites.

Very little material is available on the problems of cultivation in the western towns of Barnstable County for the period previous to 1800. From the observations of Kendall (1809) and Dwight (1822) shortly after the turn of the nineteenth century, however, we infer that the same problems of soil deterioration were encountered, though

on a diminished scale, due to the presence of Gloucester soils and of the clay layers along the northern base of the Cape Cod moraine and in the southern part of the county, often "near enough to the surface to form the subsoil" (Latimer, 1924).

Pasturing of Livestock

In his "Conclusions for the Plantation in New England", written about 1629, Winthrop gave us reasons for the practicability of emigration by the Puritans:

"The possibility of Breeding of Kine weh grows to a greater bulke of body in that country than with us, in this Kingdome, secondly, of Goates weh may easily be transported with small charge. 3dly swine weh breed in great numbers by reason of the Abundance of Acornes, groundnutts."

These statements were founded upon reports from the Plymouth settlement, upon which were focussed the eyes of all English Puritanism, particularly after the dissolution of the Parliament of 1629.

The pasturing of live stock rapidly became a major factor in the destruction of the forests of Cape Cod. Woods pasture management may be said to have begun with the burning practices of the original Indian inhabitants. Live stock used was the native deer. The white man, however, put the live stock industry on a business basis. His only contributions to pasture management technique, unfortunately, were the axe and a much more intensive use of fire.

Beginning modestly in Plymouth with one bull and three heifers, brought over in 1624, this industry expanded with great rapidity. In 1627 there were one cow and two goats to six persons, also a total of 146 swine. By 1638, cattle brought high prices and cattle

breeding was considered to be very profitable. Sandwich was settled by cattlemen from Plymouth shortly after 1634, and was organized as a township in 1637. Cape Cod was furnishing live stock to the settlers who were filling the country to the north and west.

One of the earliest sources of friction between New Englanders and the home country was wool. As early as the seventeenth century, England had become a manufacturing nation whose economy demanded cheap raw materials and a command of the market for manufactured goods. The Pilgrims had been financed by a group of business men who looked for profit in the above form. The policy of the mother country in suppressing colonial manufacture can therefore be understood.

English textiles were high in price, and money was scarce in the new colonies. With characteristic independence, the colonists insisted on manufacturing their own woolen goods. Plymouth had a fulling mill as early as 1655. In 1656 efforts were made by local governments throughout southern New England to force the home manufacture of textiles. Officials assessed each family for one or more spinners. Each one assessed must, for 30 weeks each year, spin a pound per week of lining cotton or woolen. The penalty was 12d for every pound short (Weeden, 1890). This represented the wool production of about 6 to 8 sheep for each person assessed, since wool, being cheaper than cotton, was most commonly used in the rural districts. In many towns, ordinances were passed for the clearing of commons to make room for sheep. This seems to have been carried out in larger sections of the present towns of Truro, Wellfleet, and Eastham, where the cool, damp atmosphere produced a very high grade of wool.

Cromwell's 1660 tax on wool textiles gave a final impetus to this movement. The Council of Foreign Plantations had estimated that there were 100,000 sheep in New England in 1660 (Weeden, 1890). From 7-10,000 of these sheep were in Barnstable County. In the Plymouth area, sheep were pastured heavily around the numerous ponds south of the village. Herdsmen were appointed at the town meetings.

A fulling mill is known to have existed in Barnstable in 1667. Other mills may have operated on Cape Cod, although definite records on the subject are not available.

The effect of this pasturing of the forests of the Cape must have been profound. Cattle prefer hardwood sprouts, browsing coniferous seedlings only when feed or water is scarce. Favored species are ash, oak, and maple. Sheep and goats will browse heavily on the reproduction of all broadleaf trees and conifers. It does not take many years of intensive mixed grazing to destroy the young growth in a forest. As fast as the large trees on such a grazed area are utilized for lumber and other wood products, the land is reduced to a waste of weak sprouts. If continued on an intensive scale, mixed grazing will eliminate tree growth altogether. On very light soils such as are commonly found on Cape Cod, only grasses, weeds and shrubs of low palatability finally remain where such treatment is continued.

Although no figures are available, it is known that there were fewer sheep in the western townships of Barnstable County then in those to the east. In these western townships, cattle occupied the most important place among livestock. Due to the more selective tastes of cattle, and to the poor distribution of water in western

Barnstable County, which caused a concentration of grazing in the vicinity of waterholes, it was deemed advisable by owners to burn over the cattle range systematically, in order to improve feeding conditions. At local town meetings, each year, large numbers of men were appointed to burn over the woodlands before the middle of April. Attempt was made to burn against the prevailing wind.

Utilization of Wood

We have emphasized the relatively minor effect upon the forests of land cultivation during the seventeenth century, and have shown that agriculture made more serious demands upon the forest in the form of pasturage.

Men of the soil also needed houses, fuel and fences. Trade in wood products had attractive possibilities.

The average house contains from 15 to 20 thousand board feet, or the equivalent, of wood products. Barnstable County houses ran somewhat smaller than those in the Plymouth area. Otis (1888) states that log cabins were not built in Barnstable County beyond the crude temporary structures of the first settlers. His statement to the effect that the timber was unfit for log cabins needs some modification, since excellent cedar was available in many sections of Cape Cod.

Most of the houses of seventeenth century Barnstable County were built from local planks, which were either hand-sawn or hewn from split logs. Only the wealthy could afford frame houses, and wealth was not common until the whaling, fishing and sea trading industries developed in the following century.

In 1639 a sawmill was established in Northern Plymouth County, at Scituate (Otis, 1888). This town quickly developed into an important lumber center. From Scituate came practically all of the

finished lumber used throughout the Cape Cod area during the latter half of the seventeenth century.

It is difficult even to approximate the amount of local timber used for building structures on Cape Cod during this period. In Plymouth the amount must have been almost negligible. The thousand or so farm units in Barnstable County in the seventeenth century used perhaps 30,000,000 board feet of material. When it is considered that much of this material came from the clearing of fields, it will be seen that the demand for building materials was a factor of relatively small importance from the standpoint of forest devastation.

Goodman Hallett (Otis, 1933) of Barnstable considered 40 cords of wood to be a good year's fuel supply for his seventeenth century house. Throughout the year Goodwife Hallett maintained a fire, either in the great fireplace inside of the house or in the outside fireplace at which she did her summer cooking and baking. On the basis of an average volume of 50 cords to the acre, a consumption of 40 cords per family, and the population table in Appendix "B", it is estimated that approximately 58,000 acres of the original forests of Barnstable County were cut over for fuelwood during the seventeenth century. In view of the heavy grazing and woods burning practice in vogue at the time, much of the cutover area must have reproduced very poorly, if at all.

In the Plymouth area, fuelwood was also a very important factor, but a more difficult one to measure because of the less insular nature of this area. Data on population in this area have been less easy to secure or to estimate. As nearly as can be estimated, less than one-half as large an acreage was affected in the Plymouth area by domestic fuelwood operations as in Barnstable County.

Early continental travelers in America bemoaned the extravagant use of wood fuel and fence posts by the colonists, and predicted early depletion of the forests. Zigzag rail fences protected the cultivated fields of Cape Cod from the cattle, sheep, hogs, and goats that roamed the forest, except in the proximity of the moraines, where stonewalls were gradually built up. Many of those rail fences were made of split cedar, and were a large factor in the depletion of the coastal white cedar in the swamp areas.

Clapboards which were shipped to England in December 1621 on the Fortune were split by hand. Hand-split shingles were also shipped from Plymouth to England under the pressure of indebtedness. As early as 1635 the Pilgrims were carrying on a profitable business in Europe with lumber manufactured at their outpost on the coast of Maine. Pipe staves and lumber continued to be one of the biggest items of trade with England, Spain and the Indies during the seventeenth century. It is doubtful that much of the lumber used in this trade came from Cape Cod, but oak pipe staves were sawn in the small mills that operated in the area.

An occurrence which must be considered in discussion the early forests of the Cape Cod area was the hurricane of September 1635. This storm, to quote Bradford in his "History of the Plymouth Plantation", "blew down many hundred thousands of trees, turning up the stronger by the roots, breaking the higher pines of the middle, and the tall young oaks and walnut (hickory) trees of good biggness were wound like a withe. The signs and marks of it will remain 100 years in those parts where it is forest."

To one familiar with the qualities of the trees occurring in this forest, it is evident that the "higher pines" which were broken

off were largely white pine. The trees turned up by the roots were probably beech, maple, oak, pitch pine, and hemlock, as well as some white pine.

The destruction of the Spanish Armada in 1588 brought to a climax the commercial and colonial supremacy of Spain and Portugal. England and The Netherlands were in the ascendency. Europe had turned its eyes across the seas, and there grew a demand for ships.

British naval officials quickly discovered the superiority of American white pine for ship masts, bowsprits and yard arms. And so likewise did buyers from the Indies, The Netherlands, and Ireland, and from Spain and Portugal, the two last-mentioned nations struggling desperately to recover from the catastrophe of 1588. Not only were the best prices to be had in markets outside of England, but payment in those markets were made in gold, whenever the seller so demanded, rather than in goods, as was the shortsighted policy of English buyers. The great scarcity of good currency in the colonies and the abundance of gold in the former markets created a natural economic relation in which this trade was of greatest advantage both to the colonist and to the Dutch and Latin peoples. The tremendous drain upon these forests which were located near the coast can be easily understood.

The reaction in England to this trade quickly made its appearance in the form of the King's Broad Arrow. This mark upon all accessible white pine over 2 feet in diameter was but one measure of many designed by England to cripple not only Spain and Portugal but her neighboring rival, The Netherlands. Interest in such a policy was completely absent in New England.

In those sections far separated from the water, such as New Hampshire and the Connecticut Valley, the King's agents, by watching

points of outlet, were able to control the situation fairly well. Along the southeastern New England Coast, however, ships stole into out-of-the-way harbors and loaded pine masts, yard arms and bowsprits for forbidden ports. On Cape Cod men did not grieve because of the lack of sufficient waterpower to handle large logs, when white pine masts 33-35 inches in diameter brought 95-113 and larger ones were worth up to 1600 , even in England (Weeden, 1890). Under the stimulus of such prices most of the original white pine of Cape Cod that had not been damaged by the storm of 1635 were shipped across the seas. Local officials were unable to stop the theft of pine from the town commons, so bold did these prices make the traders in masts; a fact which seems to indicate that many of these officials may have been involved in the trade.

Weeden (1890) has pointed out the fact that the demand for heavy oak ship timbers was such as to make board sawing along the coast unnecessary. The trunks of the oaks were shipped unsawn.

The expanding fleets of Europe needed not only ship masts and good oak, but also resin for naval stores. The tapping of pitch pine became yet another source of friction with England. As was the case with ship masts, the mother country desired to monopolize the supply of resin.

Turpentine brought 8s 6d per barrel delivered at the vessel, in 1678 (Weeden, 1890). One man could get a barrel of tar a week when working alone--more when working with a gang. Freeman (1858) mentions the fact that one Cape Cod town received 2 per year in 1707 from each person tapping for turpentine on the commons. In 1707, 9286 barrels of tar and pitch were shipped from America, a large portion of which came from New England (Weeden, 1890). Much was also used at home. The crude tapping methods in practice, in

conjunction with the systematic firing of the woods which was practiced at this time, was no doubt one more serious factor in the destruction of the original stand of Cape Cod pitch pine.

By 1650 the men of Cape Cod were beginning also to tap the resources of the sea on a commercial scale. Off shore, whaling became a factor in local economy. Blubber from beached whales was dried over fires along the shore, and once more the forests contributed their bit to the process. By 1667, 200 tons of oil went to England from Plymouth Colony. There is no means of telling how much was shipped in clandestine fashion to the forbidden markets of the world, but the amount was no doubt large, for the colonists suffered no qualms of conscience in evading the edicts of the Crown. By far the greater amount of the seventeenth century whale oil was consumed at home, however. The demand of this industry for fuel-wood increased constantly up to the end of the century.

In 1624 an expert saltmaker was sent to the Plymouth Colony. While he was not a personal success, his arrival marked the beginning of an industry that was destined to become one more important factor in the destruction of the forests of Barnstable County.

Much of the salt for the early fisheries and for consumption in the homes of New England came from the West Indies. The colonists liked neither its quality nor the thought of paying for a product an unlimited supply of which lay at their front door. Not until the fishing industry began to assume a place of importance in local economy, however, did the production of salt from sea water receive serious attention. By 1670, land was being granted as an inducement to prospective salt makers, largely, no doubt, for

the fuel supply contained thereon.

Until 1776 all salt was manufactured by the process of boiling sea water in open pans. The method was inefficient, and extremely wasteful of wood. One cord of wood produced from 10 to 12 bushels of salt. There are no figures on the annual production of salt in the seventeenth century, but it is safe to surmise that by the turn of the century it ran into many thousands of bushels. It was not until the seventy-five years preceding the Revolution, however, that the boiling of salt became a major industry and therefore a major drain upon Cape Cod forests.

Forest Conditions at the End of Century

The progress of forest destruction in the eastern townships of Cape Cod during the seventeenth century is indicated by the measures passed by the people of Eastham during this period. In the town records we find the following ordinances and memoranda:

1676. Sergeant Jonathan Bangs and Samuel Knowles chosen to act in town's behalf to seize knots or tar and to prosecute persons of other towns who gather knots or "run" them for tar.

1680. No Indian to cut any wood or pine knots, or to run pine knots on any of the town's commons. Indians shall not dwell on the commons. Five persons appointed to execute the order.

1680. "Stephen Atwood, Sen. hath grant of an acre of land on Nauset Hills provided he do not plant same to Indian corn."

1683. No sheep, ram or rams shall run at large upon town commons from July 1 to end of October, upon forfeiture of one-half of said ram to the informer.

1690. No wood to be cut upon commons by anyone for transportation out of town. Fine of 10 shillings per cord for breach of ordinance.

1694. Cutting and transportation out of township of wood or timber from any source prohibited.

1695. Much trouble being experienced about wood transported out of town. No person whatsoever shall cut any wood or timber on any of the commons or individual lands within Eastham. 20 shillings fine. "Great damage hath been done."

1715. The town of Truro (a part of Eastham until 1709), having found it impracticable otherwise to prevent great waste of wood on the commons, ordered that the commons be divided. Other towns followed suit about this time.

Shortly after 1700, the Reverend Samuel Osborn of Eastham began teaching local inhabitants the use of peat for fuel. Sixty-five years had been sufficient for the people of Eastham to complete the destruction of their forests. From that period to the present the most important local source of fuelwood in Eastham and other towns of the outer area has been driftwood picked up along the shores.

Forest destruction on Cape Cod during the seventeenth century diminished progressively from the easterly towns to those of the West. Accordingly, the turn of the century found considerable bodies of the original forest still remaining in the present towns of Brewster, Barnstable, Sandwich, Mashpee, Falmouth, Bourne and Plymouth. In particular, Falmouth and Plymouth seemed to have escaped best the heavy cutting which marked this period. Forest renewal must have been nearly at a standstill over the eastern

part of the Cape. It is this situation, in conjunction with the increasing effects of drought, and the attacks of insects and disease brought about by deterioration in site conditions, that hurried the destruction of the forests of Cape Cod during the centuries that followed.

PART IV

INFLUENCE OF THE WHITE MAN - EIGHTEENTH CENTURY

Land Cultivation

For better or for worse, the Pilgrims settled in a country whose soil was incapable of supporting seventeenth century, frontier, agricultural practice without upsetting the slender balance which nature had been able to maintain. Some loss in position of agriculture in eighteenth century Cape Cod economy is therefore to be expected. The area under cultivation diminished throughout the century.

Cultivated crops were gradually limited to accord with the demands of local consumers. Corn and the cereals were all ground locally. Where water power was lacking, wind was utilized, bringing a picturesque memory of the Holland sojourn to the Cape.

Pasturing of Live Stock

While land cultivation did not increase during the eighteenth century, agriculture continued its demands upon the forests of the Cape in the form of pasturage. The breeding of cattle for sale to settlers in western and northern New England was taken over by farmers established closer to the frontiers. Some beef was shipped to urban markets on the hoof from the western towns of the Cape, but milk and beef production for local consumption became the principal objective in cattle breeding very early in the century.

There is little mention of goats in the eighteenth century Cape Cod literature. Hogs, like cattle, were apparently raised only for the local larder. Salt pork, being the least perishable meat of the period, was a standard item in the diet of the fisherman.

The townships of western Cape Cod continued, far into the eighteenth century, to appoint men to run fire through local woodlands. In 1754, for example, 42 men of Sandwich were delegated at town meeting to burn over the woodlands of the town before April 16th.

The struggle for independence from English woolens continued unabatedly until 1713, when the Treaty of Utrecht was signed. Following signature of this treaty came a great influx of English capital into the colonies, largely in the form of staple commodities. Among these commodities were great amounts of linens and woolens that gradually weened the more prosperous of the colonists away from homespun goods.

It is difficult to determine the effect of this change of taste upon the total volume of spinning in the colonies, due to the rapid increase in population, a goodly portion of which was not in a position to purchase foreign goods. In view, also, of the constant demand of the English mills for raw wool, it is doubtful if this influx of manufactured woolens had any great effect upon the sheep industry itself.

Whatever shrinking in the sheep industry may have occurred after the Treaty of Utrecht was halted around the middle of the century, when the struggle of the colonies with England became intensified. At this time most towns developed spinning schools to insure higher grades of woolen goods. Factories for manufacture of goods comparable in quality to those supplied by England were encouraged. Manufactures increased rapidly up to and during the Revolution, in defiance of the edicts of the mother country. The Daughters of Liberty, in 1776, "had sessions all day long for spinning, in Providence." The President and first graduating

class of Rhode Island College were entirely clothed in fabrics of American manufacture at Commencement, in 1769 (Weeden, 1890).

In one of the smaller towns of New England, 30,000 yards of woolen cloth were manufactured in 1767. Records show the manufacture of as much as 500-700 yards of cloth by certain families each year (Weeden, 1890).

This demand for native woolens abated temporarily after the close of the Revolution, when English woolens again flooded the American markets for a time. Independence from the mother country, however, brought a great release in the energies of the peoples of the new nation. Yankee ingenuity and inventiveness came into full blossom, and with it great improvements in the manufacture of textile machinery. The total effect of this improvement in manufacture was to maintain the profits of the sheep industry, which, in turn, exacted a corresponding toll upon the forests of Cape Cod and of southern New England in general.

Utilization of Wood

The destruction of the British Navy in the great storm of 1703 increased the demand upon New England forests for ship timbers, bowsprits, and masts. The forests near the coast were combed by dealers in these items. Moreover, ship building was becoming a home industry. By 1720 Massachusetts was launching 140-160 vessels annually averaging 40 tons each. Her merchants and fishermen owned 190 vessels averaging over 40 tons. English capital, following the Treaty of Utrecht, pursued a profitable round of trade between America, the Indies and Britain. A cargo of English goods was exchanged in New England for a new ship and a cargo of lumber or fish. The latter cargo was sent to the Indies and exchanged for a

cargo of more precious goods, which were in turn brought back to England, where ship and cargo were sold (Weeden, 1890).

The flood of British goods produced an unfavorable balance in trade between America and the mother country which was estimated, a few years after the above treaty, at 200,000 annually (Weeden, 1890). The greater part of this unfavorable balance fell upon New England. The total effect was to stimulate illegal cash trade with the West Indies and the continental nations. The slave trade was particularly encouraged. Fish and lumber from New England were exchanged in the Indies for sugar and molasses. The molasses was distilled into rum in New England, which was exchanged in Africa for slaves. The slaves were in turn sold in the Indies and in the Southern Colonies. These activities exerted a constant pressure for liquidation of the forests, particularly those forests lying near the coast, from which timbers and pipe staves could easily be smuggled aboard a ship.

When the towns of Cape Cod finally gave up the futile task of guarding the town commons, during the first fifteen years of the century, many of these lands that still contained merchantable timber were picked up by investors from the larger centers. Speculation in former common lands was greatly stimulated when Parliament freed colonial export of wood and lumber in 1721. Export trade in wood products became next in importance to that in fish and vessels (Weeden, 1890). The demand for heavy timbers from Portugal, Spain and the other nations of Europe continued to be so great as to preclude the necessity for sawing. Entire trunks of trees were sent across the water in specially built vessels.

By the middle of the eighteenth century it is doubtful if any large timber remained from the original forests of Cape Cod. Yet

the demands upon the forests of the Cape were destined always to intensify, until finally these forests had been entirely consumed in the heat of the struggle for possession of a continent.

The development of turpentining in the Carolinas brought an end to that industry on Cape Cod before the middle of the eighteenth century.

During this century there developed one of the most devastating of forest industries, namely, the production of potash. The financail inflation which became more and more acute up to the middle of the century greatly encouraged the production of potash. One laborer could cut, clear and burn the wood from four acres of forest in a year. The yield of two tons per acre was worth from £40 to £60 per ton (Weeden, 1890). Unfortunately, the only references to the industry on Cape Cod are vague, and give no inkling of the quantities produced.

As inflation in the New England colonies deepened, toward the middle of the eighteenth century, English merchants were no longer able to exchange goods for ships at a profit. In 1730 there were but 41 vessels in the stocks of New England, according to official reports. By 1741 the figure had dropped to 15 (Weeden, 1890). The latter were of far greater tonnage than were early vessels, however.

Heavy duties exacted by the Crown did much to create new shipbuilding centers. Remote ports became centers of an illegal traffic in ships, the volume of which could not be estimated. In 1750 the first professional shipbuilder appeared on Cape Cod in the person of Thomas Agrey. His establishment was located at Barnstable. The industry spread rapidly along the Cape Cod shore. If any great volume of ship timbers still remained on the Cape at this time,

they were no doubt quickly spotted by these builders. Most of the material for the new ships, however, was brought in from Maine (Pratt, 1844) and other points north and east. This could indicate but one thing, namely, the lack of any great amount of proper materials on Cape Cod.

The volume of construction in the illegal shipyards was tremendous. As the foreign trade in ships diminished, shipbuilders found their best markets among the fishermen, whalers and slavers of the New England coast. Kalm (1751) gives a figure of 665 vessels in the Massachusetts cod fisheries between 1765 and 1775. Estimates of the number of vessels in the Cape Cod whaling fleet at the opening of the Revolution ran as high as one thousand. The writer has seen no estimate of size of the slave fleet.

The destruction of the New England fishing and whaling fleet during the struggle for independence had the effect only of stimulating post-Revolutionary construction in these newly established shipbuilding centers. The end of the century saw the approaching climax of the great whaling era of southeastern Massachusetts. The profits of Salem's China trade did not escape the notice of wealthy Cape Cod fishermen. Before the turn of the new century the keels of a trade that was to reach a glorious peak in the middle years of the following century were being laid in the shipyards of Cape Cod.

Not only were ships in demand, but barrels. One 240-ton whaler of 1791 sailed out of Nantucket for the Pacific with a cargo including "440 barrels with iron hoops, and about 1400 barrels with wooden hoops..." (Weeden, 1890). This was a comperatively small ship.

Cordwood used in trying blubber was the common ballast of outgoing whalers. The wood consumed by the whaling fleet must have reached an important total.

Bank fishing began in 1730, bringing with it a demand for larger ships and much more salt; for all fish were salted. It is unfortunate that there were no observers of the calibre of Dwight or Kendall on Cape Cod in the years before the Revolution to give us reliable figures on the volume of salt produced by the boiling process.

Although there are vague references to the tremendous havoc wrought upon Cape Cod forests (Brigham, 1920) through use of cordwood in boiling salt, the West Indian product was still able, at the beginning of the American Revolution, to compete with local salt to such an extent that Congress was forced to subsidize salt producers to stimulate domestic production. Under this stimulus a native of Cape Cod, one Captain John Sears, developed in 1779 the method of solar evaporation. The basis of his method was the exposure of large surfaces of shallow water to the sun's rays. This called for the construction of a great number of shallow trough units measuring 100 feet by 10 feet. Major Nathaniel Freeman brought in the aid of a windmill to pump the sea water, and Reuben Sears of Harwich, in 1793, invented the rolling roof. Stimulated by the profits of an industry that had lifted itself beyond the need for subsidy, Cape Cod producers worked out refinements in methods of manufacture during the early years of the next century that eventually spread to the west and ultimately put them out of the salt business.

In the interim, however, an industry of major proportions flourished. Production of salt at the turn of the nineteenth

century reached a figure of 40,000 bushels. The new equipment mentioned above had not yet fully replaced the old, so much of this salt was still being boiled out (Freeman, 1838). Approximately 3,000 bushels of Glauber's salts, secured as a by-product of the process, at the proportion of 1 to 15, were produced annually. Glauber's salts could be produced only through boiling of the brine which remained after ordinary salt had been removed. Approximately one cord of wood was required for the removal of 10 bushels of Glauber's salts (estimate by author).

White pine boards, plank and dimension stock used in the construction of salt sheds came by water from Maine (Dwight, 1822). The piling was local oak and pitch pine.

During the eighteenth century the iron industry became an important consumer of wood in the form of charcoal. Iron was first discovered in the bogs of southeastern Massachusetts in the seventeenth century. A small mill appeared at Taunton in 1690. The first article produced was the square nail. The production of iron goods became another source of friction between the colonies and the mother country. The colonial producers were not at all satisfied with the productions and shipment to England of pig iron. As late as 1735 only 9 cwt. of raw iron was exported. In 1740, 14 tons were exported, but high exchange as the result of inflation reduced the figure to 2 tons in 1745.

Most of the hollow ware used throughout the colonies during the eighteenth century came from southeastern Massachusetts. During the Revolution the mills of the Plymouth area were operating at capacity in the production of cannon balls and arms used by the colonial forces.

The iron industry of this section reached its full stride after the close of the Revolution. Statistics on the industry are of a scattered nature. Mr. George P. Morse, of Wareham, Massachusetts, mentions the presence of six or eight iron mills in the township of Plymouth and seven in the Wareham area during the century under consideration. One of the largest, Federal Furnace, opened in Carver in 1793. Individual plants had very checkered histories.

We see here a great split between the economy of Plymouth and that of the Barnstable area, where shipbuilding, fishing, whaling and the clipper trade were the leading activities of the same period. The rise of the iron industry in the Plymouth area was made possible by the presence of a large amount of wood that could be converted into charcoal. Charcoal was the only fuel used by these mills.

Some idea of the vast quantities of wood consumed may be gained through figures found in Griffith's "History of Carver." In 1804 the employees of the Charlotte Furnace of South Carver made 24,000 bushels of charcoal during the off season of mill operation, or enough for six weeks' run of that mill. With an annual run of about six months, the mill would seem to have required about 100,000 bushels of charcoal, or the product of about 2,200 cords of wood. Assuming that the average stand per acre at this time was 20 cords, this represented the clear-cutting of about 110 acres for the operation of one mill for one year. Since an average of about ten mills drew upon the forests of this area during the latter years of the century, the drain upon the Plymouth forests was very great.

Oak was somewhat preferred to pitch pine for charcoal, yet the latter was acceptable.

The demands of the fuelwood industry upon the forests of the Plymouth area must have been equal, if not greater, than that of the iron industry. The forests of eastern Barnstable County had been so depleted by the time of the Revolution that peat was a common fuel as far west as Brewster and Harwich. It becomes difficult, in fact, to estimate the acreage affected by fuelwood operations for local consumption in Barnstable County during the eighteenth century, because of the lack of definite information on peat utilization. Toward the end of the century, second and third-growth timber was being cut over all of the western townships of Cape Cod. On the basis of population figures, a full use of wood for fuel, and a reduction in stand to 20 cords per acre, the harvesting of some 375,000 acres of fuelwood would have been required in Barnstable County alone through the century. This would appear to be a rather high figure.

Such estimates, however, considered in conjunction with other demands upon the forest, and with heavy grazing, go far toward and explanation of the present condition of Barnstable County forests. By the end of the century very little fuelwood remained in Barnstable County outside of the townships of Sandwich, Falmouth, Bourne and Mashpee.

Forest Fires

As destruction of the Cape Cod forests progressed, the presence of slash, baked oven-dry by the sun, and the spread of huckleberries, blueberries, scrub oak, and sheep laurel, created a condition whereby forest fires on a modern scale were inevitable.

It was no longer an easy matter for the men who burned over the woods each spring to keep fires down on the ground and under control. Fires became holocausts for the first time. In 1722 a great fire is recorded in Sandwich, in which many sheep were destroyed. In 1772 another fire was reported in this area attended by great destruction of sheep and a heavy depreciation of property. Since there was no agency primarily interested in the control of forest fires, or in records of the same, there is no knowing the full extent of damage caused by fire. Profit in wool so influenced the thoughts of the people of Cape Cod that fires occurring before or after the grazing season were considered by a large portion of the population as blessings rather than ill fortunes.

By the end of the century such a complete destruction of vegetation had occurred in eastern Barnstable County that shifting sand was a common sight from Yarmouth east. Local ordinances (Kendall, 1809) had become necessary, calling for the planting of beach grass by owners of windblown soils.

Conditions at the Turn of the Century

The post-Revolutionary period in United States history was marked by a steady invasion of Europeans, largely English, who crossed the ocean to point a finger of scorn at crudities in the manners and living conditions of the citizens of this young republic. This finger pointing, incidentally, was usually publishable at a comfortable profit in England or on the Continent.

Fortunately for the present study, a certain Edward Augustus Kendall, Esq. (1809) chose to travel on Cape Cod. Kendall harbored a genuine curiosity for people and for things, and was able to give a very clear picture of all that he saw, in spite of occasional

lapses to the level of the criticism so common at this time. He visited Cape Cod in 1807.

Aroused no doubt by the aspersions of foreign observers, Timoth Dwight, president of Yale College, devoted much of his time to travel throughout eastern America around the turn of the century. His object was that of presenting a true picture of this much-maligned young nation, giving proper recognition to the good things found and holding such matters and conditions up as object lessons to those sections whose culture was at a lower level. Dwight visited the Barnstable area in September 1800 and the Plymouth and Carver areas about 1814.

The picture which these two gentlemen, with such widely different viewpoints, presented of the Cape Cod landscape agrees even in details. It is unfortunate that neither of these travelers got out of the stage coach and walked through the more remote sections of the Cape.

Dwight (1822), traveling from Plymouth to Carver, described Plymouth woods as a "vast yellow pine (Pinus rigida) plain.... An entire sameness of prospect everywhere wearied the eye; and approached in many places toward complete desolation." He noted that an iron furnace in Carver was supplied by ore from lakes, one of which yielded 500 tons in a single year. He noted that in the two counties of Plymouth and Bristol were "20 iron furnaces and as many forges, a number of slitting and plating mills, and a great number of people employed in the manufacture of nails, and other articles of which iron is the material."

Kendall (1809) noted of the Plymouth area that "the herbage is scanty, and the timber, which consists in black pine (Pinus rigida)

and oak, is of a stunted growth." Kendall traveled south from Plymouth toward Bourne.

Dwight observed that "the road from Sandwich to Barnstable was hilly and in a great degree bare, bleak and desolate; the inhabitants having universally cut down their forests and groves and taken no measures to renew them." The forest growth in both Sandwich and Barnstable was chiefly pitch pine and oak.

Between Barnstable and Yarmouth, Kendall noted, "the road enters a wood and the sand disappears....The trees are small and in places so young a growth as to afford no shade.

"Crowds of caterpillars vainly toiled in the ruts....to ascent their sides....Hosts of caterpillars march in all directions in New England."*

"From....the church in Yarmouth....commences the peculiar scenery of Cape Cod, a soil of white sand, generally covered with a sward and with forest while in a state of nature, but naked and drifting before every wind, when once laid bare to the elements; for if a small opening allow the winds to enter, then speedily tear up whole acres. The plain, around the church, in this part of Yarmouth, exhibits the effects of this violence, for, with the exception of some portions, hourly diminishing in extent, it is one sea of sand."

Dwight found the road from Yarmouth to Orleans "hilly and unpleasant....the soil principally lean....the verdure faded prematurely; the forests, which in Dennis extend along the road in

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* Mr. H. C. Brown, entomologist, U. S. Bureau of Entomology and Plant Quarantine, hazards the guess that the insect seen by Kendall was the forest tent caterpillar (Malacosoma disstria Hbn.), a native forest pest that defoliates hundreds of thousands of acres in periodic outbreaks.

one place three miles, are low and unthrifty....the surface destitute of beauty."

Dwight (1822) observed that little wood grew in Harwich, that imported wood and peat were the fuels used. In Falmouth, Kendall noted that "thickly wooded hills and steep declivities distinguish a great part of the road between Falmouth and Buttermilk, but arrived at the bay the country is more level and open,...composed of rocks and sands."

From Orleans Dwight found no forest until he reached a point one mile south of the Wellfleet line. From this point to Wellfleet village was a stand "lower and leaner than any we had seen before." A dune area in Eastham covered 1,000 acres.

The hills of Truro were dry, sandy and barren, the soil where not blowing was "covered with short grass, now russet and melancholy."

PART V

INFLUENCE OF THE WHITE MAN - NINETEENTH CENTURY

Land Cultivation

The increase in population of Cape Cod was very rapid from 1800 to the Civil War, after which date began a rapid exodus of young folk to the West and to the booming textile and shoe towns of central and southern New England. In Barnstable County, the population of 18,900 in 1800 had been doubled by 1860. It is inevitable, therefore, that there should be some increase in area cultivated. Both Kendall and Dwight noted a thriving industry in onions in the neighborhood of Barnstable, "thousands of bushels" being exported. Thoreau (1936) found that 1,000 bushels of corn had in the past been sent annually to market "above local use" in Eastham, but intimates that this was no longer possible in 1850.

Dwight (1822) found farmers around the ponds of Plymouth and Carver raising "small crops of rye and maize. Carver....is a lean-looking collection of thinly scattered plantations....and the whole aspect of the country is discouraging. Everything appears as if it had been long at a stand; and as if it could scarcely again become progressive."

Thoreau (1936), touring the Cape on three occasions through the middle years of the nineteenth century, remarked that "the thin layer of soil from Barnstable thins out and disappears at Truro". Orleans was like a great sandbar. "Generally the plowed fields look white and yellow, like a mixture of salt and Indian meal....a historian of Chatham says of a part of that town: 'There is a doubtful appearance of soil beginning to be formed. It is styled doubtful because it would not be observed by every eye and perhaps not

acknowledged by many'".

Thoreau referred to a sand waste in Eastham of 1700 acres that had once been cultivated for wheat. Not a particle of organic material remained. Sand hills 50 feet high formed in twenty-five years. Small swamps and valleys were filled. Apparently the sand area mentioned by Dwight had increased in size.

The cranberry industry, which had its first success in Dennis in 1816, developed rapidly in Barnstable County until nearly all cedar swamps that had not been exploited for peat were cleared and cultivated by the end of the century. The clearing of cedar swamps by the cranberry men is largely a twentieth century development in the Plymouth area.

As has been stated, the area of cultivated land in the Plymouth section increased very little after the seventeenth century, until the advent of the cranberry industry at the end of the nineteenth century.

Pasturing of Livestock

The rise of the woolen textile industry in New England coincided with the importation of Merino sheep from the royal herds of Spain. Profiting by the chaos of the Napoleonic Wars, a Vermonter in the diplomatic service of the United States (Wilson, 1936) was able to purchase a large herd of Merinos for breeding purposes. The Merino adapted itself readily to the climate of New England and to the demands of the woolen industry. Vermonters performed miracles in breeding. The farmers of Cape Cod quickly purchases stock, with rejuvenating effect upon their herds and pocketbooks. Thoreau, in 1850, remarked that Truro "a few years

before was remarkable among Cape towns for the number of sheep raised." By 1850, however, Vermont breeding stock had helped build up a great sheep industry in western United States and in Australia. Thoreau found only two herds in Truro in 1850. This corresponds with the decline of the wool industry in Vermont. Except for a temporary boom during the Civil War, the industry had by 1850 entered a sharp and permanent decline.

The Plymouth area also experienced a boom in wool production during the first half of the nineteenth century. Mr. George F. Morse of Wareham relates that up to 1850 all sheep owners from Rochester, Carver and Wareham drove their sheep into the area between Agawam River and Sampson Brook. At least 10,000 sheep were pastured there. The plains around Charge and Fearing Ponds were especially good feeding grounds. The low areas around College Pond and the ponds immediately south also contained much grass. Full-time herdsmen kept an eye on the sheep.

Cattle from Mattapoisett and Rochester also seem to have been herded by "men of Plymouth" (Leonard, 1907).

In Barnstable County, the peak of agricultural expansion was reached in 1860, when 30.6 per cent of the county was classified as farmland. This compared with 65.2 per cent for Massachusetts as a whole. Of the total area involved--some 79,000 acres--only 54,336 acres were improved. The remainder was brushy pasture and woods. Pasturage rights were, in addition, leased from owners of purely woodland areas.

The amount of farm land in Barnstable County did not drop greatly from 1860 to 1900. The census figures for the respective years are 30.6 per cent and 29.6 per cent of the land area. The

proportion of brushy pasture and farm woodland was much greater in 1900, however. Pastures in 1900 were seeding rapidly to pitch pine.

Utilization of Wood

Although a considerable volume of sawed materials was produced during the nineteenth century, lumber production on Cape Cod was definitely a minor activity. Except for the existence of a small cooperage industry in Barnstable County, all known mill operations were in the Plymouth area.

Mr. George P. Morse, town surveyor of Wareham, Massachusetts, who has long been interested in local forest history, has stated that a considerable amount of white pine remained within five miles of the Buzzard's Bay shore until 1900. He mentions the presence during the nineteenth century of eight or ten long sawmills, each with a cut of ten to fifty thousand board feet per year. Pitch pine as well as white pine was sawed. All lumber was used locally. These were up and down mills, with pitch pine flutter wheels. One such mill was located at the foot of East Head reservoir. The exact period of its operation is not known.

A product of much greater importance in the Plymouth area during the nineteenth century, according to Mr. Morse, was slack cooperage, for which pitch pine was preferred. Most of the stock went into nail kegs, the demand for which was a heavy throughout the century. Six mills operated in Wareham in 1870, each with four machines which turned out 10,000 18-inch staves daily per machine. The operation of these plants was seasonal. The total volume of timber utilized by the mills in the Plymouth area reached

rather surprising proportions. The writer ventures an estimate of 6,000,000 board feet per year taken from the Plymouth area during good times, on the basis of Mr. Morse's figures.

A barrel ship operated in Harwich for many years, but the writer has very little information on the volume of barrel production in the Barnstable area in this or any other period.

The mackerel fishery progressed rapidly after its inception in the early part of the nineteenth century, receiving great impetus with the development of the purse seine in 1853. The production of mackerel firkins from white pine occupied at least two Wareham mills for an unknown period during this century. It is impossible to estimate the volume of wood utilized. Neither is it known whether or not other mills in the area manufactured this product. An unknown quantity of barrels for shellfish also was manufactured. Oak was preferred for these.

Shipbuilding was a minor industry along the Plymouth shore. Pitch pine was commonly used for ribs and knees (Leonard, 1907). Shipbuilding in Barnstable County was a major industry, however. Practically all materials used were brought to the shipyards by water, the most important source being Maine. Although mention is made in several recent popular books on Cape Cod of the use of Barnstable County wood for the construction of ships during the century under discussion, the writer agrees with Brigham (1920) that the volume of this wood was insignificant.

Freeman (1838) reported a salt production for Barnstable County of 40,000 bushels in 1802. Dwight (1822) listed areas of salt vats totaling 1,513,130 square feet for the same year. Kendall (1809) reported the production of salt five years later as

100,000 bushels. He listed areas of vats at this time totaling 30,827,700 square feet. While there seems to be a discrepancy here, construction was no doubt ahead of salt production at the latter date. A tremendous expansion of the industry occurred under stimulation of the Restricted Commerce Act of 1809, which compelled abolishment of commerce with England and France, and placed a duty of 12 to 30 cents per bushel upon salt. This duty remained until after the War of 1812 (Church, 1909).

Expansion of the salt industry continued until approximately 1840, when competition with the salt mines of the interior became very keen. In the Congressional Records of 1830, the current production of Barnstable County salt works was reported to be 392,537 bushels. Data on the industry contained in these same records tell more clearly than could any words the story behind the sudden and complete disintegration of the salt industry on Cape Cod, after 1840.

	Investment	Men Employed	Production Bushels	Price per Bushel
Barnstable County, Mass.	$1,379,971	590	392,537	.39
Onondaga County, N. Y.	402,200	180	1,291,820	.40-50

One factor which made salt production extremely expensive in Barnstable County was the cost of wood used in the salt sheds, all of which, with the exception of the piles, came from Maine. At the peak of production, about 125,000,000 board feet of white pine was in use. Approximately 30,000,000 board feet of pitch pine and oak was in use as piling. Yarmouth, which attained a peak production of 565,000 bushels of salt, was forced to import most of the piling, as were all of the towns to the east. A considerable amount of the imported piling came, no doubt, from Plymouth, where a wood shipping center of some size developed at Harlow's Landing, just south of

Salt Pond in Ellisville, during this century.

The production of Glauber's salts ran into many thousands of bushels, but at times did not maintain its position with respect to ordinary salt, due to an oversupply on the market. Production estimates are difficult to make, due to this unevenness in production. For some ten or fifteen years, however, the demand for fuel wood for the boiling of these salts must have been close to 1500 cords per year.

Containers were not used for salt, as it was shipped in the bulk. A large amount of the brine left after salt had been removed was sold at $1 per barrel, but it is doubtful if Cape Cod was able to produce at this time all of the tight, oak cooperage stock needed for these barrels.

By 1845 the iron industry had moved as far east as Dennis, in Barnstable County, where there were seven forges. One furnace operated at Sandwich for many years. Forges at Yarmouth employed 32 persons in 1845. Dennis and Yarmouth forges were no doubt occupied with gear for the shipbuilding industry. A considerable amount of charcoal was used at these forges, and this, together with the charcoal used at Sandwich, constituted a minor industry in this county (Crowell, 1852).

The demand for charcoal in the iron industry of the Plymouth area increased steadily until the advent of the cupola furnace, about 1830, which used Pennsylvania coal for fuel. The production of iron during the first thirty years of the nineteenth century was far greater than at any time during the previous century. The history of the iron industry was attended by many ups and downs in the history of individual plants, which make an estimate of charcoal consumption impossible. The drain upon the forests of the

area must have been particularly serious during those first thirty years.

Bloomeries and forges continued to use charcoal after 1830. The iron industry lost ground rapidly after 1850, however, as the result of competition arising out of the discovery of rich ore deposits in the lands to the west. Nail manufacture continued to resist the trend until about 1875, when it too began slowly to lose position.

In the years after the American Revolution, a great demand for fuelwood developed in the rapidly growing industrial centers of New England. As the forests near these centers were depleted, wood was shipped in from ever greater distances. Unfortunately for their forests, the people of Cape Cod profited greatly as the result of these new markets. Dwight (1822), in a diary written in 1800, remarked that 30 vessels were employed in the transportation of fuelwood from Sandwich to Boston.

Early in the century--namely, January 1837--a very illuminating article appeared in the "Yarmouth Register". The writer deplored the high price and scarcity of wood and recommended forestry measures, including the withdrawal of cattle from the forests. He also urged the use of stoves rather than fireplaces. Mention is made of the increasing use of peat for fuel, and there is a description of the highly subdivided ownership of peat bogs in the eastern townships. "Every ten rods is considered equal to an acre of woodland." Peat sold for 12½ cents per barrel. A dollar's worth of peat was said to maintain a fire as long as two dollars' worth of wood. The writer bemoaned the existence of an "aristocracy of wood sellers."

With the collapse during the middle years of the century of the whaling, salt, wool, shipbuilding, glass and iron industries,

and of the China trade, and the gradual concentration of the fishing industry in Boston and Gloucester following developments in refrigeration and in methods of fishing, the laboring classes of Cape Cod were forced either to find employment in new or expanding local industries, or to migrate to other sections of the nation, or to reduce their standard of living. The pressure of unemployment prevented any cessation in the exploitation of Cape Cod forests. The cutting of fuelwood is said to have been the most important source of income of the people of Falmouth from 1850 to 1890. Older residents of this town remember when Megansett, or North Falmouth, was an important wood shipping center. One individual recalled having seen "miles of wood piled up" at this point when he was a boy. This was approximately 1875. The last boatload of wood left Falmouth about 1900. A large part of the wood cut in Falmouth throughout this period was oak.

The deeply sunken roads that form such an intricate pattern through the eastern half of Plymouth Woods give some indication of the large volume of wood that was taken out through Plymouth and Ellisville during the nineteenth century. Mr. George P. Morse has estimated that in 1850 about 150 men from the towns of Carver, Rochester and Wareham were engaged in Plymouth woods cutting the fuelwood and wood for charcoal which came out through Wareham and Carver. These men worked four months each year in the woods, and averaged between one and two cords per man per day. This would indicate a total cut of approximately 20,000 cords of wood which was utilized either as fuelwood or as charcoal each year. The favorite wood was oak, according to Mr. Morse, large blocks of which were present in the territory west of Halfway Pond.

A very important factor in the later history of the forests of western Barnstable County was the construction of the famous Sandwich Glass Works, in 1825. It is said (Crowell, 1932) that a representative of the company spent two years acquiring woodlands before the mill was constructed. Pitch pine was the most desirable fuel because of the intense heat developed by it. By 1845 the industry had expanded until it boasted of payroll of 316 persons. From 1825 until the passing of the industry in 1888, the drain upon the forests of western Barnstable County by the glass furnaces was a very severe one.

Pennsylvania coal does not seem to have offered much competition to wood as a fuel on Cape Cod until the last quarter of the century. In Barnstable County homes, as far west as Yarmouth, peat was used as fuel until 1870.

The appearence of stoves in the first half of the century gradually cut the local consumption of wood from 40 cords to about 15 cords per family per year, an immense saving, but unfortunately one which came too late to greatly affect the forests of the Cape.

Forest Fires

It was not until the nineteenth century that uncontrolled forest fires became chronic. As the process of exploitation intensified, those areas in Plymouth and in western Barnstable County that had managed to retain a semblance of forest form presented conditions more and more hazardous from the standpoint of forest fires. The presence of slash was a constant hazard from the origin of the colony, but that factor of which we must never lose sight was the change in vegetative cover which was the inevitable result of the abuse to which these forests had been subjected.

Centuries of light burning by the original Indian population had left a large area of forest, was somewhat park-like in appearance, with a ground cover largely of grass. When the white man combined a cutting of the overstory with heavy grazing and much more intensive burning, however, shrubs began gradually to assume a place of dominance in the vegetation of the drier areas.

In the eastern townships of Barnstable County, where sheep grazing was extremely intensive, only the unpalatable species of grass, herbaceous weeds and shrubs could maintain their position. In the western townships of this county, and in the Plymouth area, where sheep grazing was not carried on so intensively or so constantly and where large areas without a water supply excluded more than casual grazing, cutting and burning was just the type of culture most conducive to the spread of the shrub species. The dessicating effect of wind and sun handicapped the grass and trees, but had little effect upon the shrubs. The increased root competition of the latter made more and more difficult the reestablishment of the tree species. The increasing severity of forest fires further handicapped pitch pine and the arborescent oaks, and reduced their sprouting vigor, but tended to give the shrubs new vigor, in much the same way as would a pruning. Insects and diseases began to attack the weakened trees. Scrub oak, laurel, the heaths and green brier spread across the landscape. Fires became holocausts.

The impenetrability of the hinterland, particularly in western Barnstable County, was far greater at the beginning of the nineteenth century than in the days of Thomas Morton. Access to very large areas was confined more and more to town roads, many of the woods roads having become overgrown as the timber to which they formerly provided access disappeared. The tangle of roots on the

ground made the construction of fire lines extremely slow in contrast to the fast traveling head developed by fires. In the absence of proper public sentiment and organization, any serious attempt on the part of an interested few would have been an enterprise extremely hazardous to human life. It is not surprising, therefore, that fire fighting was extremely crude as to method and was attempted only when the fate of homes and lives was at stake. So unpopular and hazardous was the task that it became a local custom in Barnstable County for men of one town merely to back fire in such a manner as to head a fire into, or to confine it to, a neighboring township, whereupon the fire fighters returned home. In any event, matches and torches became the standard equipment of fire fighters. The question has been posed by the late Mr. Lincoln Crowell, fire warden of Barnstable County, as to which has done more damage in the past--the original fires or back fires.

Unfortunately, little record was kept of forest fires during the nineteenth century. They became so common that only those which were particularly destructive of property and lives are recorded. Even these records must be dug out patiently from current newspaper files.

In a local newspaper (Yarmouth Register, 1837), for example, we read of the great fire of 1837 in the Plymouth area in which much wood in piles was lost. Mr. George P. Morse has described to the writer a great fire in the early seventies "which killed most of the white pine in Plymouth Woods." The great fire of May 18 and 19, 1896, is described at length in local newspapers (Wareham Courier, 1911). This fire started near Kinney's stave mill at South Wareham railroad station and covered a strip roughly from Charge and College Ponds on the west to the Agawam River on

the east. It ran north to the Symington estate near Halfway Pond and to Long Pond Village. H. O. Cook, State Forester of Massachusetts, states (1938) that the acreage covered by this fire was estimated to be 30,000 acres.

The pessimism of generations who had never seen timber of any great value on Cape Cod, and who had come to believe that the soils of the area were not capable of supporting a "real forest", no doubt contributed to the lack of interest shown during the late nineteenth century toward fire control.

With the coming of the railroad to Sandwich in 1848, a new and unrealized resource thrust itself upon the consciousness of the people of Cape Cod. Coastal scenery and a quaint historical background were in demand by tired and bored city folk. The railroad crept to Yarmouth in 1865 and to Provincetown in 1873. Hotels and summer homes mushroomed along the ocean shore. Cape Cod folk soon learned to play down the depressing scenery of the interior.

Neither the railroads nor the summer visitors contributed to the improvement of that scenery, however. A market for oak and pitch pine ties developed. Sparks from the locomotives started additional fires. Special excursions organized by the railroads brought large numbers of enthusiastic but irresponsible week-enders to the Cape, creating a situation more and more discouraging to the pioneers of fire control. Those persons who wished to build summer homes were forced to avoid the beautiful but dangerous sites along the lakes of the interior.

PART VI

INFLUENCE OF THE WHITE MAN - TWENTIETH CENTURY

Land Cultivation In a Period of Social Change

The agriculture of the twentieth century has been of a somewhat different nature than was that of previous periods. The last milk train was discontinued about 1920. A few sheep remained in Truro at the turn of the century, but these had become an unimportant factor in local economy. Villagers gave up their horses and cows, with the result that pitch pine began to creep toward the lines of houses.

The acreage of farms in Barnstable County had shrunk to 9.0 per cent of the land area by 1930, representing a total of 21,871 acres, of which about 8,000 acres were available for crops and pasture. The abandonment, between 1860 and 1930, of some 58,000 acres, located for the most part in the eastern, central and southern portions of the country, largely explains the presence of an extensive area of old field pitch pine in these sections. About 10,000 of the 21,871 acres of farm lands of 1930 were also actually forested, largely with pitch pine. We see, therefore, an increase in the forest area in these sections of the Cape where the forests were first and most thoroughly wiped out.

The greatest agricultural change in the Plymouth section during the twentieth century has been the expansion of the cranberry industry to bogs of that area. This has been attended by an influx of cranberry workers, most of whom cultivate small garden patches.

The year 1929 introduced a new cycle in the agricultural history of Cape Cod. During the census period 1930 to 1935 there occurred an increase of 132% in the number of farm units in Barn-

stable County (See Appendix "C").

The area of farm land increased 92%. The value of all farms increased only 33%, however.

The expansion of agriculture during this period has been purely a depression phenomenon, a fleeing of distressed families to the land. Most of the lands recently occupied had previously gone through the cycle of cultivation and abandonment, due to inherently low, or depleted soil fertility. The type of agriculture attempted on these lands is largely of subsistence character. Nearly all cash crops are truck and small fruits. Most of the new owners are dependent upon a supplementary income from outside sources for the satisfaction even of the barest essentials of family life.

Data on the agricultural trend during this period, in the Plymouth area, are not available. It is believed that similar developments, on a modified scale, have taken place in this area, however.

It is pertinent to note the accelerated increase in the colored segment of the population during the twentieth century. One and three-tenths per cent of the total population of Barnstable County was colored, in 1860. In 1900, the figure was 2.2%, while in 1930 it had risen to 5.1%. It is believed that another sharp increase has taken place in Barnstable County since 1930, as indicated in the data on farm owners contained in Appendix "D". Although it is impossible to separate data for that section of the Plymouth area, under discussion, it is believed that the population increase for this group has been even more striking there, particularly in the rural sections.

Excluded by circumstance from a proportionate share in the earnings of the summer industry on Cape Cod, most members of this

colored group are dependent upon the soil for a living. Because of their low standard of living, they have been able almost to monopolize the labor on cranberry bogs. Because of their industry and skill as gardeners, they have been able to grow very good crops of vegetables and small fruits on very inferior soils. In spite of intensive cultivation and a low standard of living, however, the simple mathematics of population (See Appendix "B") has created a critical problem.

The recent influx of unemployed white workers from the mill towns of Rhode Island and southeastern Massachusetts, reflected in Appendix "C", has further complicated the labor situation. A study of Appendix "C" indicates the fact that the economic status of the new white farm owners was lower in 1935 than was that of colored farm operators in 1930, and approximately the same as that of colored operators who have settled in the area since 1930. The significance of rural poverty to forests will be discussed in the section on "Forest Fires", below.

Wood Utilization and Forestry Activities

The story of wood utilization on Cape Cod during the present century is a simple one. Fuelwood is the only important forest product. Although coal and fuel oil have replaced wood as a fuel in many Cape Cod homes, these fuels are beyond the means of an important segment of the Cape Cod population. A local supply of wood remains a vital factor in their personal economy.

A small market has existed for railroad ties, but the disappearance of local timber of tie size has now dried up activities in this direction.

An attempt made at Sandwich in 1921 to conduct a pulping oper-

ation in pitch pine was abortive.

Late in the nineteenth century it became apparent to many citizens that certain problems could not be solved short of public ownership and control. Through the initiative of the Trustees of Public Reservations, a private organization working in the interest of conservation in Massachusetts, the Provincelands behind Provincetown became public property. A program of dune stabilization and reforestation has been carried out since that time. It has since become apparent to those concerned that the production of wood on these new soils is a minor element in this enterprise.

In 1917 the Legislature of Massachusetts voted to establish the Myles Standish Forest, in Plymouth and Carver townships. On this forest some 2500 acres of coniferous plantings of various species have been made. A variety of cultural measures have been carried out within native stands of timber. The records of these forestry operations lack detail and continuity, so that it is not possible at this time to comment upon them.

Recent activities upon Myles Standish Forest have been concerned largely with the development of facilities for forest recreation.

Another state forest of several thousand acres extent was established within the townships of Sandwich and Bourne, in 1925. This was first known as the Shawme Forest, later the Shawme-Crowell Forest. The area has recently been incorporated into the artillery range of the Massachusetts National Guard. During the seventeen years of its existence as a state forest, a considerable amount of this area was planted to coniferous trees, most of which were produced in a nursery located within the forest boundaries. Many parcels of state-owned land located throughout Barnstable County were

likewise planted by the veteran forester, Lincoln Crowell, who had charge of state forest activities in this area. Records of these and other state forestry activities in this area are in the files of the state forester.

Largely through the activity of the Trustees of Public Reservations, a fourth important forest area was turned over to the State of Massachusetts in 1934, namely, the Roland Nickerson Forest Park, located in the township of Brewster. Most of the activities on this forest since its establishment have been concerned with the development of facilities for forest recreation.

Other Industries

For two and a half centuries the economy of Cape Cod was built around certain very tangible resources and traditional activities, notably, the soil (producing cultivated crops, forage for livestock, and wood), the sea (producing fish, whales, salt, and an avenue for trade), mining (for the production of glassware and iron), and construction (ships and railroad cars).

There remains today of this group only agriculture, which is still a very important source of income, due primarily to the presence of bogs suitable for cranberry production; and fishing, which has shrunk to a shadow of its former importance.

Manufactures of textiles and rope, located within the village of Plymouth, have maintained a fairly strong labor market, but the population directly affected lives either outside or on the far northerly edge of the area under consideration.

During the past fifty years, a strange new industry has developed, that of feeding, lodging, clothing, transporting and

entertaining summer visitors. This industry has become the most important factor in the economy of Cape Cod today. It was created by a remarkable complexity of geography (proximity to urban centers), sedative village scenery, admiration for a remarkably virile historic past, bracing climate, a shore which permitted the eye to wander without inhibition upon a fresh and primitive landscape, and coastal waters in which bathing, boating and fishing could be enjoyed.

The interior of Cape Cod was long looked upon by summer visitors merely as a waste area through which it was necessary to pass in order to reach distant shore points. The growth of the summer industry, therefore, has tended to create a concentration of accommodations and services along the shore. The dry, scrub-covered lands of the interior still remain too forbidding in aspect to attract the large numbers whose expenditures provide most of the bread and butter of the people of Cape Cod.

Approximately $25,000,000 is now being spent on Cape Cod each year by the summer people. Expressed in terms of population, this represents a theoretical income of approximately $500.00 for every man, woman and child in the area. Expressed in terms of the land, it is equivalent of an income of $73.00 from every acre of land on Cape Cod. It is one thing to indicate average income, however, and another to consider the actual distribution of this income. A very considerable portion of the profits of the summer trade has been taken by outsiders who have financed hotels, real estate developments, tea houses, general services, and highway construction. College students and roving hotel workers have taken many of the better positions in the summer industry. Large though this income may be, it has not been sufficient to penetrate in any great amount to many of the more out-of-the-way homes of the Cape.

Since 1930 it has become difficult to determine just what will constitute normality of employment in the near future on Cape Cod. With the destruction of her forest capital and the deterioration of much of her farm soil, Cape Cod has lost some of her economic resiliency in the face of misfortune. Her relief rolls are now long with the names both of white and of colored persons. It has been necessary for the State to take over supervision of the finances of one township in Barnstable County.

Forest Fires

By the beginning of the twentieth century, large sections of the forests of Cape Cod had become veritable tinderboxes. The vegetational trend which has been outlined in earlier sections of this paper was accelerated by the intensive exploitation and the great forest fires of the nineteenth century. Few forest fires in this area originate either spontaneously or as the result of dry electric storms, however. Fires on Cape Cod are the product of human activity.

According to our statisticians, most of the forest fires on Cape Cod at the present time originate from the following causes:

Carelessness of automobilists, picnickers, and hunters.
Incendiarism
Brush burning around homes and cranberry bogs.

Not only does the automobile bring hundreds of thousands of persons to Cape Cod from far distant points, but on week-ends it brings a great swarm of picnickers from near-by cities. These week-end visitors soon discovered the lovely waters that lay hidden among the little hills of Cape Cod. Today, observers in the fire towers of Cape Cod are able to follow the advance of week-end traffic

out of Boston and other large cities, during periods of high fire hazard, by the advancing line of spot fires. When conditions are particularly bad, the haze from forest fires frequently limits observation to a scant mile or two radius from the tower by three or four o'clock on a Saturday afternoon. Towermen are commonly making reports on from three to six or more fires at a time.

Forest incendiarism on Cape Cod may be broken down into three categories or motivations, namely, the desire to produce a crop of blueberries, the desire to create work, and pure maliciousness (a state of mind which may have arisen out of unemployment and malnutrition). Economics is either the sole, or a contributing factor in each of these motivations.

Pressed by genuine want, many members of the low income group have been forced, in traditional Cape Cod fashion, to work out their own destiny. Excluded by circumstance from a more conventional sharing of the income from the summer trade, these people have profited by the knowledge that one well-timed forest fire will create a sea of blueberries almost anywhere in central or western Cape Cod. The market for these berries flows up and down the highways of the area in an endless stream throughout the blueberry season. For what more could a needy but willing laborer ask?

During the present century, many values have become twisted. Means often become ends; and so fire fighting has become a seasonal job for a certain element of the local population, with a rate of pay which is higher than that earned on many cranberry bogs. Some of the greatest forests fires of the present century, in this area, have been motivated by the desire of one or more persons to create work.

Maliciousness as a motivation for incendiarism is a factor whose relative weight it is practically impossible to determine. There are few genuine contributions to our knowledge of this matter, though no dearth of opinion. These opinions usually vary according to the asperity of the contributor.

Many serious fires originate from brush burning around houses and cranberry bogs, due to unexpected changes in wind velocity and direction, to failure to put out the last spark, and to careless issuance of permits. This source of forest fires should be one of the easiest to control.

Forest Parasites

One of the most disconcerting aspects of the modern forest problem on Cape Cod is that of damage from insect pests and diseases, particularly the former. Kendall's observations in 1907 indicate that insect attacks are not a new thing on Cape Cod. There is no reason for believing, however, that attacks of parasites in the past even approached in severity those of the twentieth century. The loss of complexity of the forest cover is in itself justification for such a position. Great expanses of mixed oak, and of pitch pine afford food concentrations and invite widespread damage. The reduction in fertility of forest soils, as the result of three centuries of intensive mismanagement, has brought with it lowered tree vigor.

While the records of the past forty years are not complete, it is known that many thousands of acres have been defoliated by attacks of the forest tent caterpillars (1), and that severe damages

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(1) Malacosoma disstria, Hbn.

has been incurred by sawflies (2), leaf miners (3), loopers (4), midges (5), twig and tip moths(6), scale insects (7), and rusts (8). The most destructive parasite that has visited the forests of Cape Cod, however, has been an introduced species, the gypsy moth (9). This insect first became an important factor in 1914. Subsequent outbreaks occurred in 1918, 1919, 1921, 1925, 1928, 1929, and 1932 and every year since the last date (Brown, 1930). No other section of New England is attacked so severely or so frequently by this insect as is Cape Cod (Fig. 6). The aimless history of these forest areas has provided a vegetational trend perfectly suited to the needs of this insect. It will probably remain a nuisance to summer people, to owners of real estate, and to operators of cranberry bogs as long as the forests remain unmanaged.

(2) Lophyrus lecontei, Fitch; and Diprion simile, Hartig.
(3) Gelechia pinifoliella, Chambers.
(4) Ellonia athearia, L. Walk. New York Harper
(5) Diplosis resinicola, Sack.
(6) Evitria comstockiana, Fernald; and Rhyacionia buoliana.
(7) Matsucoccus spp.
(8) Peridermium spp., and Gallomorium spp.
(9) Porthetria dispar (L.)

PART VII

SUMMARY

At the time of the Pilgrim landing, approximately 97% of the land surface of Cape Cod was covered with forest. On the higher elevations this forest was park-like in appearance and xerophytic in type. Between the higher and the lower elevations there was a gradual transition to a mesophytic type whose principal tree species were white pine, hemlock, pitch pine, red and white oak, white ash, yellow birch, beech, red maple, tupelo, sassafras and holly. Stands of coast white cedar occupied the bogs.

For two hundred and fifty years these forests contributed a constant stream of products that enriched almost every important economic activity of the people of Cape Cod. The ability of these forests to continue growth of such an immense quantity of wood in the face of systematic burning, excessive pasturing, damage to site through clear-cutting, and heavy attacks of insects and fungi is one of the amazing stories of American forest history.

The stream of wood products from the forests of Cape Cod has finally tapered off to a mere trickle, however. Much of the forest area today is occupied by a tangle of scrub growth, and the trees that are present are stunted by fire, the attacks of parasites and the depletion of the soil. At the same time there has been lost most of those industries to which the area in the past has been peculiarly adapted. These two trends have been closely parallel and often related.

Within the past few decades the entertainment of summer vacationists has become an industry of greater proportions than any that has preceded in Cape Cod history. The summer industry has filled the vacancy left by the decay of nineteenth century industry in a manner

that has been highly satisfactory to a large section of the population of Cape Cod. Because of its seasonal nature, however, this industry cannot provide a complete answer to the economic needs of that large class of local citizens whose only, or principal, asset is its labor.

The summer industry of Cape Cod has been built around a certain environmental complex, one of whose most important elements is the beauty and unspoiled nature of coastal lands and shore. Because of the hazard of fire and the low aesthetic value of the forest area of the interior, housing and servicing developments of this industry have been concentrated along the shore to the extent that the very values which have attracted the industry are, in many places, now being threatened. This threat arises not merely from the effect of concentration of summer population and restrictions of private owners upon the enjoyment of the landscape, but from the financial restrictions to newcomers offered by speculative valuation of a diminishing area of desirable land. Thus, indirectly, the forest areas which were at one time such an asset to the people of Cape Cod have become, through mismanagement, an actual liability.

Because of this present hazardous condition, these forests are a further and direct liability in that the cost of fire suppression has become a great burden to the towns of Cape Cod and to the Commonwealth of Massachusetts.

The lowered productivity of the soil has not led to an abandonment of exploitative processes. These have merely become more desperate and distorted in nature.

Forestry activity on Cape Cod during the present century has lacked the guidance of a consistent, well-defined policy. Local organizations are still occupied almost exclusively with the problem of fire suppression.

DISCUSSION AND CONCLUSIONS

The subversion of the forest and soil capital of Cape Cod has proceeded without pause for three hundred years. This destruction has been the result neither of chance catastrophies* nor of the activities of a few unrepresentative individuals. It has been a perfectly normal development, the logical and inescapable result of the economic and social standards which were accepted during these three hundred years.

In this we see the complete refutation of the theory commonly advanced in discussions of the lumber industry that a condition of scarcity will automatically remove the economic barriers to proper forest practice. In fact, as the resources of the land on Cape Cod have become depleted, it has become increasingly difficult for those who depend upon the land to survive. Many persons have been forced off the land, while others, ironically, have been forced back on to the very same land, necessitating a more intensive cycle of exploitation. Trapped upon an impoverished land, many of these people have had to resort to such desperate extremities as that of starting forest fires in order that they may be paid to extinguish them, or of accepting public aid which too often has represented a tax upon the unearned income of future society.

When the economic status of persons living upon the land has been reduced to this level, they have neither sufficient working capital, the physical and intellectual energy, nor even a secure enough grip upon any particular piece of land to attempt the rebuilding of that land. It becomes increasingly difficult for persons so situated

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* Evidence on the later yield of these forests precludes classification of the hurricane of 1635 as "catastrophic".

to maintain the level of soil fertility even on those lands on which they are producing annual crops. It becomes impossible for them to act constructively with respect to a crop for whose earliest possible maturity they must wait many decades.

It may be argued that the economic barriers which apply with respect to scarcity operate over larger areas; that the entire national scene must be taken into consideration, since the nation, rather than Cape Cod, is an economic unit; that when a national lumber scarcity has become an accomplished fact, then the application of proper forestry measures will become economically feasible on Cape Cod. The answer may be found in literature of the American forestry profession. There has been emphasized, again and again, the increasing rigidity of the barriers to private forestry practice which are set up by the depletion of forest and soil capital, barriers which represent the same or comparable factors as now operate on Cape Cod; namely, the hazards of fire, insects and diseases, the problem of working capital, the problems of financial and plant organization created by uneven distribution of age classes, the effect of increasing taxes upon land whose productivity is low, the problem of production costs, the competition of virgin forests in other parts of the world.

Of significance in this matter is the lack of evidence to indicate that deterioration of forest and soil capital has proceeded any more rapidly on Cape Cod than in other sections of this nation; or, for that matter, in many of the other lands of this earth (Bennett, 1939). It is well to remember that the forests of Cape Cod were capable of yielding a very respectable volume of wood more than 200 years after the arrival of white settlers, that the peak of agricultural development was not reached until some 225 years had passed, that agriculture still remains an important source of income on Cape Cod, although much

of that income in derived from soils that have been exploited for less than one hundred years (i.e., cranberry bogs). The situation with respect to the exploitation of the forest resources of Cape Cod would appear to differ from that in most of the other sections of this land only in the matter of time. It might be said that the exploitative process on Cape Cod has reached a greater maturity than in areas more recently settled.

It may be further argued that the situation on Cape Cod is complicated by the development of the summer industry, that the rebuilding of her forest capital is no longer a relevant issue, since it has been overshadowed by the economic importance of that industry. The summer industry on Cape Cod, in the last analysis, represents a form of land use. If the present study has done nothing else, it has indicated the complete interrelationship and interdependence of all forms of land use. The problem refuses to divide itself into arbitrary spheres of influence and action. The problems of the summer industry are linked with those of forestry and agriculture, not merely because this industry is incapable of providing year-around employment to certain people of Cape Cod, but because of the increasing difficulty, in the face of forest conditions in the interior, of preserving the subtle balance of values which is the foundation of that industry. The circle is rendered complete and vicious by the fact that those forest conditions are adversely affected by the struggles of the rural population for survival.

Finally, the same standards which created present forest conditions on Cape Cod still operate with respect to the summer industry. The progress of the summer industry on Cape Cod has been an amazing phenomenon. So too was that of the sheep industry, the salt industry, the iron industry, the fuelwood and the glass industries. The summer

industry is a comparatively recent development. If this industry is permitted to develop suicidal tendencies, the effect will be to place a further strain upon the forest areas of Cape Cod.

It does not lie within the scope of the present paper to present a specific program of action. In the first place the forest problem on Cape Cod is linked so closely with other aspects of the local economy that it is dangerous even to suggest a general program of public land purchase, since the effect of such a program, if attempted without regard for other factors in the situation, might be to further unbalance the local economy.

Land has no value in itself. It is valuable only when used. Extensive acquisitional activities by public agencies should await an intensive study of social and economic life on Cape Cod, originating locally, whose purpose it is to determine the cultural and economic means by which the productive activities of her people may be coordinated and expanded. Such a study will necessarily lay the basis for a redistribution of land ownership and for proper land use.

Until such a study has been made, and until such a program has been translated into action, it is unlikely that the present trend of depletion of the land resources of Cape Cod can be reversed.

APPX X "A"

LAND CLASSIFICATION - BARNSTABLE COUNTY

1927 Survey by the
Massachusetts State Forester*

Per cent of Total Area, Exclusive of Water Surface and Salt Marsh

Township	Idle Land	Oak	Scrub Oak	Pitch Pine and Oak	Pitch Pine	Agricultural	Shifting Sand	Residential	Cedar	Total Acres
Bourne	3.8	5.1	44.5	15.1	5.8	7.7		18.0		26,189
Sandwich	2.7	24.1	43.2	7.2	8.3	9.5		5.0		16,652
Falmouth	4.1	38.3	6.8	12.5	12.6	12.7	.9	12.1		28,438
Mashpee	8.9	11.8		25.8	47.8	4.0		1.7		15,269
Barnstable	8.6	13.4	2.5	21.7	22.0	18.2	.6	13.0		38,506
Yarmouth	11.0	6.4	.6	4.8	58.3	13.3		5.6		14,398
Dennis	11.5	3.3	12.7	6.1	33.4	24.9		7.6	.5	12,464
Harwich	4.0	27.3	1.2	20.0	22.1	14.7		10.7		12,405
Brewster	13.1	32.9	2.1	6.7	26.7	17.4		1.1		13,772
Chatham	4.1	11.7	5.9	5.2	28.4	28.4		16.3		9,370
Eastham	6.6	7.4	4.8	2.2	18.5	27.8		32.7		7,365
Orleans	.7	9.9	-	3.6	31.0	43.5		11.3		8,717
Wellfleet	21.8	6.1	1.5	2.8	34.0	2.6		31.2		11,752
Truro	35.5	2.8	.4	-	14.8	6.4		40.1		12,927
Provincetown	53.2	25.6					13.8	7.4		5,446
Grand Total	19.8	16.4	12.0	11.4	22.4	14.2	.6	13.2	.1	243,670

Forest by Diameter Classes - Per Cent of Total Land Area

8-10" d.b.h.				.1					.1	.1
2-7"		2.2		2.4	4.6				.1	9.3
2" and under		14.2	12.0	9.0	17.7					52.9
Total		16.4	12.0	11.4	22.4				.1	62.2%

* Unpublished manuscript. All figures above are derived from data contained in this manuscript.

APPEN X "B"

BARNSTABLE COUNTY, MASSACHUSETTS - POPULATION STATISTICS 1640-1930

Township	Year Organized	1640	1650	1675	1700	1725	1764	1776	1800	1830	1850	1870	1900	1920	1930
Sandwich	1637	200	400	1000	900	1200	1449	1912	2024	3367	4470	3694	1448	1458	1437
Bourne	1884	from Sandwich											1657	2530	2895
Mashpee	1871	from Sandwich										348	303	242	361
Falmouth	1686	from Sandwich			300	800	1225	1355	1802	2548	2519	2237	3500	3500	4821
Barnstable	1639	200	600	1200	1600	1800	2108	2610	2964	3974	4901	4793	4364	4836	7271
Yarmouth	1639	200	500	1000	1200	1200	2000	2800	1727	2251	2595	2423	1682	1229	1794
Dennis	1793	from Yarmouth						(1790)	1408	2317	3257	3269	2333	1536	1829
Harwich	1694	from Yarmouth			500	1000	1500	2392	2987 (1810)	2463	3258	3080	2334	1846	2329
Brewster	1803	from Yarmouth							1102	1418	1525	1259	829	688	769
Chatham	1712	from Yarmouth				500	677	930	1351	2130	2439	2411	1749	1737	1931
Eastham	1646		300 (1684)	650	850	600	1331	1700	659	966	845	668	502	430	543
Truro	1709	from Eastham				500	700	900	1152	1549	2051	1269	767	554	513
Provincetown	1714	from Eastham				(1748) 15	205	500	812	1710	3157	3865	4247	4246	3808
Wellfleet	1718	from Eastham				300	550	800	1207	2044	2411	2135	988	826	823
Orleans	1797	from Eastham							1905	1799	1848	1323	1123	1012	1181
TOTALS		600	1800	3850	5350	7900	12127	15597	18918	28541	35276	32774	27828	26670	32305

Numbers in italics are estimates. Data from 1830 to 1930 from official U. S. censuses. All other data from miscellaneous sources.

APPENDIX "C"

ANALYSIS OF CERTAIN DATA ON AGRICULTURE - BARNSTABLE CO., MASS. - BASED ON U.S. CENSUS OF 1935

	All Farms			White Operators			Colored Operators		
	1930	1935	Change in Value	1930	1935	Change in Value	1930	1935	Change in Value
Farm Population	1,988	4,712	+137%						
Number of Farms	484	1,123	+132%	467	1,011	+121%	17	112	+559%
Area in Farms-Acres	21,571	42,002	+ 92%	21,688	40,628	+ 87%	183	1,374	+651%
Value of Farms	$5,045,512	$6,719,857	+ 33%	$4,973,142	$6,403,532	+ 29%	$72,370	$316,325	+323%
Average Value Farms	$10,425	$5,985	- 42.6%	$10,650	$6,335	- 40.5%	$4,250	$2,825	- 33.5%
Average Value Farms New Since 1935		$2,604			$2,629			$2,462	
Change in Value New Farms vs. 1930 Farms			- 75%			- 75.3%			- 42%

APPENDIX "D"

POPULATION DATA - BARNSTABLE CO., MASS. - 1930 - U.S. BUREAU OF CENSUS

Age	All Classes			White		Native		Foreign born white		Negro	
	Total	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Under 1	502	257	245	228	222		1			24	17
Under 5	2741	1418	1323	1264	1168	3	4			119	111
5-9	2876	1429	1447	1282	1281	13	15			105	124
10-14	2679	1379	1300	1241	1164	13	17			107	93
15-19	2505	1275	1230	1136	1092	44	50			83	76
20-24	2332	1182	1150	1031	989	84	81			57	68
25-29	2181	1151	1030	927	853	151	151			54	39
30-34	2060	1062	998	841	784	151	164			60	37
35-44	4103	2023	2080	1419	1505	460	487			123	72
45-54	3761	1801	1960	1288	1410	397	462			102	75
55-64	3402	1657	1745	1270	1329	318	378			50	26
65-74	2367	1139	1228	958	1013	157	187			18	20
75 & Over	1284	558	686	476	590	74	76			4	14
Unknown	54	27	27	24	24	1				2	3
Total	32305	16101	16204	13157	13222	1866	2052			884	758

"About 370 children under 5 years of age per 1000 women 15-45 years of age (childbearing age) are required to maintain population stationary at the 1930 expectation of life in the United States of 61 years." (Baker, 1939).

These ratios are as follows for various social groups living within Barnstable County.

	Ratio	Surplus (+) or Deficit (-)
Native white	469.	+ 27%
Foreign born white	7.7	- 98%
All white	407.	+ 11%
Colored	785.	+112%
U.S. average, rural, non-farm	471.	+ 27%
U.S. average, rural, farm	545.	+ 47%

APPENDIX "E"

FARM LAND ACCORDING TO USE - U.S. CENSUS 1935 - BARNSTABLE COUNTY

	1929 Acreage	1934 Acreage	Change in Value
Total Cropland	5,153	10,546	+104. %
Plowable Pasture	1,872	3,100	+ 66.
Woodland Pasture	641	637	- .5
Other Pasture	1,202	921	- 23.4
Woodland not Pastured	9,397	21,658	+130.5
Other Land	3,401	4,940	+ 45.
Total Land Available for Crops	7,030	13,646	+ 94.
Total Farm Land	21,871	42,002	+ 92.

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Fig. 1. A STAND OF PITCH PINE THREE YEARS AFTER A SEVERE FIRE.

Sprouts have developed from the base of the trees and new shoots have developed on such portions of the stem as have remained alive. The resistance of pitch pine to fire is one of its most valuable traits. Trees frequently injured, however, may have extremely poor form. Town of Sandwich.

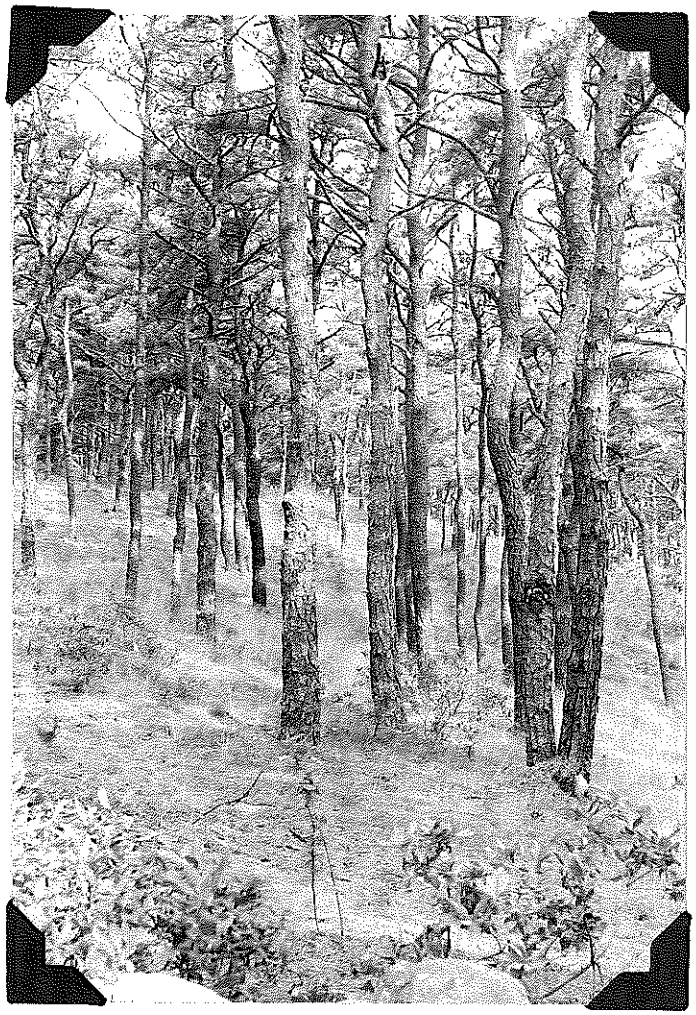


Fig. 2. OLD FIELD PITCH PINE SIXTY YEARS OLD GROWING ON COARSE SAND.

Previous to reforestation, this area was severely grazed for a period of unknown duration. It is unlikely that fire has been an important factor in the history of this stand.

Fig. 3. YOUNG PITCH PINE STAND WHICH HAS BEEN KILLED BY THE LOOPER, Ellopia athasaria, Walk.

Myles Standish State Forest, Town of Plymouth.

Fig. 4. A PITCH PINE STAND WHICH HAS BEEN SWEPT BY REPEATED FIRES. Town of Wareham.

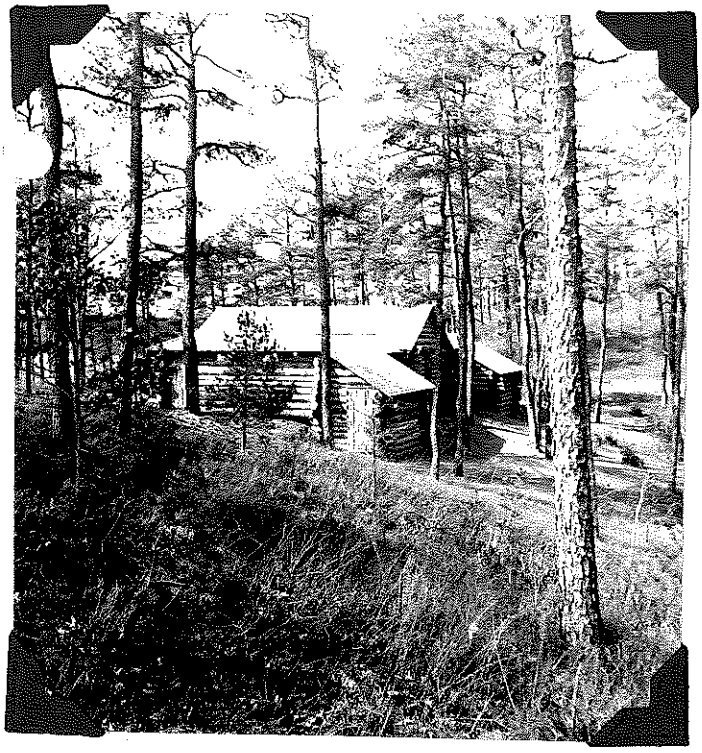


Fig. 5. LARGE-SIZED PITCH PINE ON A PROTECTED AREA USED FOR RECREATION.

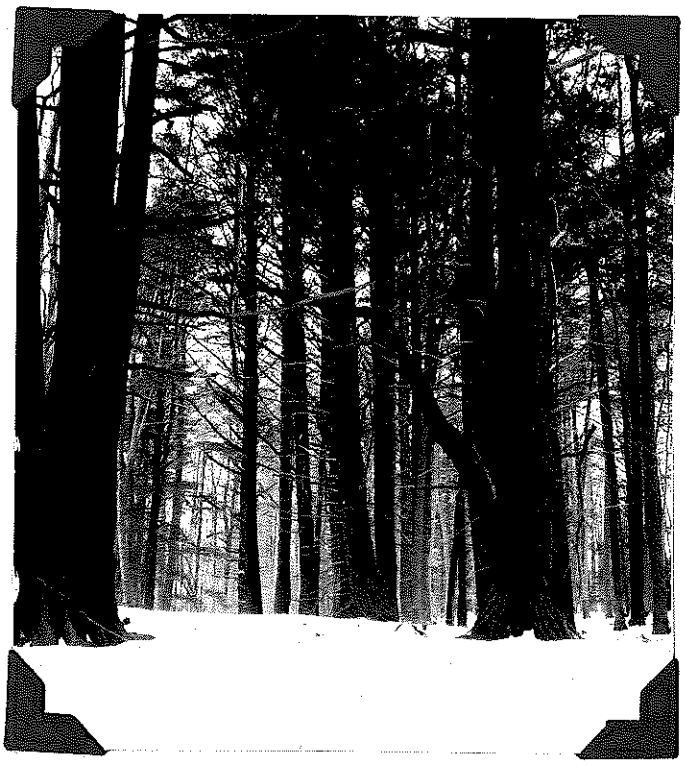
College Pond, Myles Standish State Forest, Town of Plymouth.

Fig. 6. MIXED OAK STAND COMPLETELY DEFOLIATED BY GYPSY MOTH.

Picture taken in August, Town of Brewster.

Fig. 7. AN EXTENSIVE AREA OF SCRUB OAK.

This area suffered from a severe fire ten years previous to time of photograph and was planted shortly after to red pine. Large boulders indicate the coarse~~ness~~ character of surface material.



Figs. 8 and 9. FOREST RELIC INDICATING CHARACTER OF THE ORIGINAL MESOPHYTIC ASSOCIATION ON CAPE COD.

Mixed hemlock, beech, yellow birch, red maple, pitch and white pine, tupelo and holly. Stand is located on an island in the center of Halfway Pond, Plymouth. Land immediately surrounding this pond bears a cover of scrub oak and stunted pitch pine.