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THE INDIAN AS AN ECOLOGICAL FACTOR IN THE NORTHEASTERN FOREST¹

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There is a popular belief that the discoverers of eastern North America found everywhere an unbroken forest of giant trees. This belief has had much support from our popular literature. In the backdrop for *The Landing of the Pilgrim Fathers*, "The woods against a stormy sky their giant branches tossed" (Hemans 1826). America's fireside poet made us aware that, "This is the forest primeval" (Longfellow 1847). It has been said that a squirrel might have gone from Maine to Louisiana by leaping "from one giant tree to the next" (Bear 1951); might have travelled from bough to bough for a thousand miles without seeing a flicker of sunshine on the ground (Adams 1935); might indeed have travelled a squirrel's lifetime without coming down out of the white pines (Peattie 1950).

The vast, virgin forest recurs constantly in the works of Parkman (1909 a, b). He pictures for us "One vast, continuous forest . . . the depths of immemorial forests, dim and silent as a cavern." He paints Verrazzano off the New England coast surveying "the shadows and gloom of mighty forests." Between the French and English colonies lay "a broad tract of wilderness, shaggy with primeval woods." There was Maine, a "waste of savage vegetation"; the White Mountains "throned in savage solitude"; the Adirondacks, a "mountain wilderness"; Lake George lying in the "wild charm of untrodden mountains and virgin forests." Frontenac's army approached Onondaga "among the dense columns of the primeval forest," and across Pennsylvania "a prodigious forest vegetation . . . wrapped

the stern and awful waste in the shadow of the tomb . . . a realm of forests ancient as the world." The Saint Lawrence River rolled through the "vastness of lonely woodlands." Champlain ascended the River Wye in Ontario through "the primeval woods" and the Ottawa River through "ancient wilds, to whose ever verdant antiquity the pyramids are young and Niniveh a mushroom of yesterday."

Lillard (1947) thought the dominant feature of America at the time of discovery was the virgin woods.

Many botanists seem to share the popular belief in an unbroken virgin forest and to assume that human interference with natural succession commenced with white settlement. They appear to overlook or dismiss as unlikely the possibility of significant disturbance by the Indians. The claims of some foresters and ecologists, notably Maxwell (1910), Hawes (1923), Bromley (1935, 1945), and Gordon (1940), constitute a challenge to them and call attention to the fact that a fundamental question is still unsettled. Therefore, it seems desirable to examine the evidence further in order to improve our estimate of the Indian as an ecological factor. In this paper, attention will be largely confined to Indian activities in New England, New York, and New Jersey.

VILLAGE CLEARING

Practically all of the northeastern Indians lived in villages which varied in size and permanence. Establishment of a village involved clearing for home sites and foraging within a considerable radius for the plants and animals necessary to the Indians' way of life—foods, fiber, medicines, wood and bark for utensils, weapons, canoes, and houses and particularly for fuelwood. In short, the woodland Indian

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drew upon the forest for a great variety of products (Densmore 1927, Speck 1938, Speck and Dexter 1951).

The temporary dwellings of a nomadic family band might be accommodated by a small partially-cleared area, while semi-permanent villages occupied clearings of considerable magnitude. In the Iroquois country, stockades sometimes enclosed as little as 2 acres and sometimes were 767 paces in circumference. Land outside the stockade was often cleared and occupied, the entire village site covering as much as 100 or 150 acres (Parker 1920).

Undoubtedly many village sites are still undiscovered, but archeologists have found hundreds in New England, New York, and New Jersey (Parker 1920, Willoughby 1935, Cross 1941). Knowledge of the village sites in an area is clearly fundamental in studying disturbance of the forest.

FUELWOOD CUTTING

Beyond the village and fields, the Indian women carried on a never-ending search for fuelwood (Lafitau 1724). Although the small dead and down trees, sometimes referred to as "squaw wood," may have been picked up first, it is probable that live standing trees were systematically cut. This is probable because an Indian village used a large amount of firewood and exhaustion of the local supply meant moving the village (Williams 1643, Mather 1702, Lafitau 1724, Loskiel 1794). So important was firewood in Indian economy that the Narragansetts of Rhode Island thought the English had come to America because they lacked firewood at home (Williams 1643).

The prodigal use of firewood by the Iroquois and Delawares, which shocked Loskiel (1794), suggests that they had a more substantial supply than dead and down trees and makes it likely that they would make use of all the wood they could obtain nearby. Lafitau's statement that the longer an Indian village was occupied, the farther the forest receded from it clearly indicates that all trees were

cut. Settlers found the site of Boston so clear that they had to go to the islands in the harbor for fuelwood (Bromley 1935).

The Indians knew how to fell trees with stone axes and fire (Sagard 1632, Lafitau 1724, Kalm 1770, Waugh 1916). Some doubt may exist concerning the ability of Indian women to clear the primeval forest, but it appears that the men commonly cut the trees and left only the splitting and carrying to the women (Lafitau 1724, Parker 1910), although Indian women themselves were capable axe-wielders (Eastman 1902).

AGRICULTURAL CLEARING

Although considerable dependence was placed upon hunting, fishing, and collecting wild plant foods, the practice of agriculture was widely dispersed over the Northeast.

The northern Algonkians were hunters, but in the early seventeenth century, Champlain found the tribes along the Ottawa River and around Lake Nipissing growing a little maize, an art which they probably learned from the neighboring and friendly Hurons (Hunt 1940). The Montagnais-Naskapi also, who even now live by the chase (Speck 1935), were growing maize in 1634 (Thwaites 1896). By 1535, the Iroquois had pushed maize culture down the Saint Lawrence Valley as far as Quebec (Anon. 1600). In the next century, they had retreated from this region, and, according to De la Chesnaye's memoir of 1697, the nomadic Alkonkians were pointing out to the French colonists young forests arising on former Iroquois village sites (Bailey 1933).

Waugh's (1916) supposition that agriculture was practiced in the Maritime Provinces rests on Verarzanus' (1582) rather vague statement that the savages towards "Penobscot Bay and Newfoundland" were "ruder and less agricultural" than those to the southward. Verarzanus, however, was not attracted by the northern coast of North America, and

he does not appear to have examined it in detail. At the mouth of the Saint Lawrence River, Cartier (1580) saw no signs of agriculture and around Chaleur Bay only trees and "wilde corne," which was probably wild rice. Champlain (1613-32) knew the Souriquois of Nova Scotia and the Etchemins of Sainte Croix and Penobscot Bay as nomadic hunters and fisherman. Eckstorm (1945) called the Etchemins "sea-faring, tide-dwelling Indians, expert canoe-men, hunting principally the porpoise and the larger fishes." Neither Champlain nor Smith (1616) found maize fields along the coast northeast of the mouth of the Saco River, nor did Waymouth see any along the lower Saint George River (Rosier, 1605).

Champlain learned that maize was being grown in the interior in 1605 and had been grown at the mouth of the Kennebec River until enemy raids made it unprofitable. Its abandonment may have been recent, as Smith observed that along the Kennebec "where the Salvages dwelt there the ground is exceeding fat and fertill." Perhaps as a consequence of this move, the eastern Indians were raiding the coasts of Massachusetts for maize shortly after the arrival of the Pilgrims (Bradford 1898). There are other indications that the Saco River was not always the northeastern limit of agriculture on the coast. The vicinity of Mattawamkeag and Old Town, on the Penobscot River, was cultivated early (Eckstorm 1945), and in 1776, Pownall recorded that there were "old worn-out clear Fields," extending down river 4 or 5 miles from Old Town.

In southern New Hampshire, the Penacooks apparently shared the semi-agricultural culture of the southern New England tribes (Speck 1928). Explorers found agriculture generally practiced along the coast from the Saco River southward, and Smith (1616) noted enthusiastically that the coast of Massachusetts "shewes you all along large corne-fields" and that there were "many Iles all planted with corne." Pring (Anon.

1625) observed Indian "gardens" on Cape Cod, one an acre in extent.

The many fields, which the first settlers found after the plague had nearly exterminated the tribes around Massachusetts Bay, attested the extent of Indian agriculture in this region. *The Planters Plea* stated that the plague had left "in many places, much cleared ground for tillage" (White 1630). The Reverend Higgeson (1630), a resident of Salem, was more explicit: "I am told that about three miles from us a man may stand on a little hilly place and see divers thousands of acres of ground as good as need be, and not a tree in the same." Although this is hearsay, it is substantially confirmed by the appended letter of the engineer, Graves, who reported "open plains, in some places five hundred acres, some places more, some lesse, not much troublesome for to cleere for the plough to goe in."

In 1602, Edward Winslow and Stephen Hopkins found both sides of the Taunton River "for the most part cleared. Thousands of men have lived here which died in the great plague" (Willoughby 1935). These were the Pokanokets. The populous Narragansetts were also agricultural (Williams 1643), as were the Indians of Connecticut (Trumbull 1797). Southern Massachusetts was cultivated by the Nipmucs (Pynchon 1856, Speck 1928) and the Connecticut River Valley as far north as Vernon, Vermont, and Hinsdale and Winchester, New Hampshire, by the Pocumtucks (Hurd 1886, Sheldon 1895).

Northern New Hampshire and Vermont were more thinly settled, but some clearing for agriculture took place. The Cohass Intervales in the upper Connecticut Valley may be cited as an example. The first settlers found them nearly clear as the consequence of intermittent cultivation. Three or four separate clearings took place within historical times, namely, about 1628 by Mahicans from the Hudson Valley, possibly again in mid-century by Pennacooks, in 1704 by an unidentified band, and after 1725 by the

Pequawkets (Crockett 1921). The Indian name of the Intervales is striking testimony of its history—*koasuk*, the place of *little* white pines (Laurent 1884, Masta 1932).

The New England tribes in general "cultivated large quantities of maize, beans, pumpkins, and tobacco" (Mooney and Thomas 1906), and their clearings were probably responsible for the "many rich and fruitful spots of land . . . without trees or stones, near the banks of great rivers" in the New England which Hubbard (1815) knew.

The earliest observer of western Vermont and the Adirondacks was Champlain, who accompanied a war party down Lake Champlain in 1609. His Algonkian allies told him that the valleys on the Vermont side of Lake Champlain were cultivated by the Iroquois, but the war party did not actually encounter the Iroquois until it reached the vicinity of Ticonderoga. Champlain may have misunderstood his informants, who may have referred to a temporary cultivation by the Iroquois during their retreat from the Saint Lawrence sometime after 1541 (Fenton 1940).

Champlain also thought the Algonkians said that the Adirondack Mountains were thickly populated, but the paucity of archeological remains in this region suggests that the reference may have been to the proto-historic village sites in Jefferson and Fulton Counties. The Iroquois do not seem to have occupied the Adirondacks, although hunting and fishing camp sites are known (Parker 1920). Pownall (1776) could obtain no information about the region, but it is probable that the Indians were less ignorant than unwilling to give information about a favorite beaver-hunting ground.

Historians of New Netherland made frequent allusions to the agriculture of the Hudson River tribes. They mentioned large treeless flats "of seven or eight leagues and less" (Anon. 1851) and "very fine flats and maize lands" which had "few or no trees" (Anon. 1856).

Henry Hudson bought maize from the Indians below the site of Poughkeepsie, New York (Juet 1610), and near Hudson, New York, he saw a bark storehouse containing "a great quantity of maize and beans" and drying beside the house "enough to load three ships, besides what was growing in the fields" (De Laet 1625). In 1636, the location of several maize fields along the River were noted by DeVries (1655). According to Jogues (1851), the first settlers around Albany used fields which had been cleared and abandoned by the Indians.

In 1626, Long Island, Staten Island, and the land between the Hudson and Hackensack Rivers were occupied by Indians who supported themselves by planting maize. Manhattan had good land on the north side, and on the east side there was a level field of 140 to 160 acres in such condition that it could "be ploughed without much clearing." The good land on the east side of the River above Manhattan "where formerly many people have dwelt" had been abandoned following war with the Wappingers (Rasieres 1628?).

It is probable that the first white men on the scene here and elsewhere underestimated the amount of land which had been cleared by the Indians. This is suggested by Van der Donck's (1656) statement that, although there were large meadows in New Netherland, there would be "much more meadow ground" but for its quick reclamation by woods. More than once he was unable to recognize as former Indian cornfields land which had been out of cultivation only 20 years.

The Iroquoian tribes placed great dependence on agriculture (Parker 1910, Waugh 1916). At one time they grew maize, beans, squashes, sunflowers, artichokes, and tobacco, and soon after contact with the white men they were raising many European fruits and vegetables and even hogs. Early observers made numerous references to their large fields and caches of stored produce. In On-

tario their fields were so extensive that when the missionary Sagard (1632) travelled from village to village, he lost his way in the fields more often than in the woods. Champlain (1613-32) traversed 60 to 90 miles of this region and called it "a well-cleared country." The peninsula between Lake Huron and Georgian Bay was mostly cleared.

Among the Mohawks of New York State, the unknown author of the journal of 1634 (Anon. 1895) ate baked pumpkins and observed in some houses more than 300 bushels of stored maize. The military expedition of Tracy and Courcelles in 1666 destroyed "prodigious quantities of provisions." Cornfields extended for two miles on each side of an Onondaga village near Pompey, New York. In 1696, Frontenac's army spent three days cutting the corn in fields which stretched four to six miles from the Onondaga fort near Jamesville, New York (O'Callaghan 1850).

In 1669, Galinée (1875) visited a Seneca village near Victor, New York, which stood in a clearing six miles in circumference. In 1687, Denonville's expedition destroyed a vast quantity of cached and standing corn at four Seneca villages. His estimate of 1,200,000 bushels may have been exaggerated, but ten days were required for the work of destruction (O'Callaghan 1850).

Sullivan's expedition into the Iroquois country in 1779 found an agriculture of surprising abundance. Every few miles his army stopped to destroy "a large quantity of corn" and "a great many fruit trees." After two days at Newtown, New York, the army moved on, because it would have taken too long to destroy all the crops there. The town of Genesee was "almost encircled with a clear flat, which extended for a number of miles, covered by the most extensive fields of corn, and every kind of vegetables that can be conceived." Among the Cayuga orchards, which were destroyed, was one of 1500 fruit trees. Sullivan estimated that his force destroyed corn at 40 vil-

lages which "at a moderate computation, must amount to 160,000 bushels, with a vast quantity of vegetables." About the same time, Brodhead's troops were destroying more than 500 acres of cornfields along the Alleghany River and "a great quantity of corn in New Ground" along French Creek (Cook 1887).

After the Iroquois were dispersed, the first settlers and surveyors found in some places recent clearings (Brown 1943) and in other places pineries covering older clearings (Gordon 1940).

The early Dutch historians considered New Netherland to be all the country between the Delaware and the Connecticut Rivers, so their general statements about the Indians of New Netherland seem to apply to the Indians of New Jersey. They were said to live chiefly on maize, which they had in abundance (Wassenaer 1621-31, De Laet 1625, DeVries 1655). The Indians encountered near Sandy Hook had "great store of Maiz" in 1609 (Juet 1610). Rasieres (1628?) could learn little about the Indians between the Hackensack and the Delaware Rivers because of the enmity between the tribes, but we know now that the Indians of New Jersey were agricultural even into the eighteenth century (Loskiel 1794, Brinton 1885).

Evelin's account of "New Albion" in 1648 stated that settlers might obtain from the New Jersey Indians two thousand barrels of corn (Smith 1765). At a later date, settlers found considerable cultivated land along the Delaware River (Lindeström 1925), but it remains for archeology to locate many village sites in this imperfectly known area (Cross 1941).

It appears probable that early writers saw only a small part of the agricultural clearing in the Northeast. Fields were abandoned as they wore out or as the white settlements came close. These abandoned fields grew up to forests. Occasionally expeditions striking at centers of Indian population saw Indian agriculture as it was, as when General Wayne

reached the village of the Miamis and their allies in 1792 and found a continuous planting the whole length of the Maumee River from the present site of Fort Wayne to Lake Erie (Mooney and Thomas 1906).

FIRE

The Indians of the United States commonly fired the forests and grasslands. Indeed, Hough (1926) regarded fire as a hunting aid used by primitive peoples generally. Information on Indian burning in the western part of the country has been summarized by Stewart (1951). He found numerous reasons for burning: driving game, improving visibility, facilitating travel, driving away reptiles and insects, increasing the supply of grass seeds and berries, and for offense and defense in war. Burning was commonly practiced in the Central States (Loskiel 1794, Carver 1796, Michaux 1803, Ashe 1808, "New Yorker" 1835, Gray 1884, Shaler 1884, Marsh 1885, McClure 1899, Wislizenus 1912, Blane 1918, Shantz 1924, Bakeless 1950) and in the Southeast (Maxwell 1910, Swanton 1928).

The earliest travelers observed burning along the coast from Florida to New Hampshire. At Roanoke, Drake's chronicler noted that fires "are very ordinary all alongst this coast, even from the Cape of *Florida* hither" (Biggs 1600), Verarzanus (1582) saw "verie great fiers" along the Carolina coast in 1524, and at Roanoke, White's (1600) expedition, following a smoke, found no sign of man. At another fire, they found only "grasse and sundry rotten trees burning." Percy (1625) saw fires set by Indians on the south side of Chesapeake Bay. This may well be the explanation of the forest of "trees without underwood, and not standing so close but they may anywhere be rode through" which "An American" (1775) observed in Virginia and Maryland. Fire-hunting was a trait shared by the Carolina, Virginia, and Potomac Indians (Flannery 1939), and Smith (1625) has left us a good account of its use by

the Virginia Indians. Inland, fires were common east of the mountains, and more than 1000 square miles of burned, treeless land in the Shenandoah Valley stretched northward into Pennsylvania (Maxwell 1910, Bakeless 1950).

Hudson's crew saw "a great Fire" on the shore somewhere south of Sandy Hook (Juet 1610). In 1632, DeVries (1655) smelled smoke from fires, set by the New Jersey Indians to improve their autumn hunting, even before he could see land. Smith (1765) recorded the practice of fire-hunting in New Jersey, and Budd (1685) wrote of New Jersey. "The *Trees* grow but thin in most places, and very little Under-wood." Standing alone, this statement would permit only surmise as to the cause of these open woods, but Denton (1670) and Lindström (1925) link them to the annual burnings by the Indians. Denton reported that between the Raritan and the Delaware Rivers, there were "but a few Indians," "stately Oaks" with "broad-branched-tops" and "grass as high as a mans middle, that serves for no other end except to maintain the Elk and Deer, . . . then to be burnt every spring to make way for new." Lindström noted the abundance of thin, loosely-rooted high grass and the trees which "stand far apart, as if they were planted" and observed the firing of the dry grass to open the spring hunt. The Lenâpé Indians continued to burn the woods deliberately in the spring and fall and accidentally at other times after they had left New Jersey (Loskiel 1794). The New Jersey woods were still being burned in 1748, although Kalm's (1770) reference was probably to fires set by leaf-burning white settlers. Several observers have attributed the dominance of pines in southern New Jersey and the dwarfed growth of the "Plains" to these fires (Pinchot 1899, Stone 1911, Lutz 1934, Moore 1939).

The journals of early observers give us a rather clear picture of Indian burning along the coast of southern New England. In 1524, Verarzanus penetrated 15

to 18 miles inland from Narragansett Bay and observed "open plains twenty-five or thirty leagues in extent, entirely free from trees or other hindrances" and forests which "might all be traversed by an army ever so numerous" (Verarzanus 1582).

In 1602, Brereton (1602) remarked that the trees on Cuttyhunk grew "distinct and apart . . . upon greene grassie ground." The next year the Indians set fire to the woods on Cape Cod where Martin Pring was cutting a cargo of sassafras "which we did behold to burne for a mile space" (Anon. 1625). In the early days of the Plymouth colony, two men, becoming lost, wandered onto a "place where the Savages had burnt the space of five miles in length" (Anon. 1626).

Two early witnesses of burning in the Massachusetts Bay area wrote at some length.

The Salvages are accustomed, to set fire of the Country in all places where they come; and to burne it, twize a yeare, vixe at the Springe, and the fall of the leafe. The reason that mooves them to doe so, is because it would other wise be so overgrowne with underweedes, that it would be all a copice wood, and the people would not be able in any wise to passe through the Country out of a beaten path . . . for this custome hath bin continued from the begininge. . . . For when the fire is once kindled, it dilates and spreads it selfe as well against, as with the winde; burning continually night and day, untill a shower of raine falls to quench it. And this custome of firing the Country is the meanes to make it passable, and by the meanes the trees growe here, and there as in our parks.

(Morton 1632)

And whereas it is generally conceived, that the woods grow so thicke, that there is no more cleare ground than is hewed out by labour of man; it is nothing so; in many places, divers Acres being cleare, so that one may ride a hunting in most places of the land, if he will venture himselfe for being lost: there is no underwood saving in swamps and low grounds that are wet . . . for it being the custom of the *Indians* to burne the wood in *November*, when the grasse is withered, and leaves dryed, it consumes all the underwood, and rubbish, which otherwise would over grow the Country, making it unpassable, and spoil their much affected hunting; so that by this means in those places where the *Indians* inhabit, there is scarce a

bush or bramble, or any combersome underwood to bee seene in the more champion ground. . . . In some places where the *Indians* dyed of the Plague some foureteene yeares agoe, is much underwood, as in the mid way betwixt *Wes-saguscus* and *Plimouth*, because it hath not been burned.

(Wood 1634)

In the spring of 1633, the Plymouth colony went to work clearing the woods for cornfields, "the Lord having mitigated their labours by the *Indians* frequent fiering of the woods, (that they may not be hindered in hunting Venson, and Beares in the Winter season) which makes them thin of Timber in many places, like our Parkes in England" (Johnson 1654).

We can obtain a glimpse of the *Indians'* attitude from Roger Williams' (1643) theological arguments with his Narragansett friends.

When I have argued with them about their Fire-God: can it say they be but this fire must be a God, or Divine Power, that out of a stone will arise in a Sparke. . . if a spark fall into the drie wood, burns up the Country, (though this burning of the Wood to them they count a benefit, both for destroying of vermin, and keeping downe the Weeds and thicketts?).

It is conjectural how far up the coast the practice of burning the woods extended. The writer has found no early witnesses of actual fires north of Massachusetts Bay, but there are descriptions of the kind of forest which elsewhere early writers attributed to fires. In 1607, Captain Gilbert described the trees at a point on the Maine coast—probably Point Elizabeth south of Casco Bay. They were "the most p^t of them ocke and wallnutt growinge a greatt space assoonder on from the other as our parks in England and no thickett growing under them" (Anon. 1880). Richmond Island nearby had "fine oaks and nut trees with cleared land and abundance of vines which in their season bear fine grapes" (Champlain 1613-32). Along St. George's River, and inland from it Waymouth found

good ground, pleasant and fertile, fit for pasture, for the space of some three miles, having but little wood, and that Oke like stands left

in our pastures in England. . . . And surely it did all resemble a stately Park, wherein appear some old trees with high withered tops, and other flourishing with living greene boughs . . . the wood in most places, especially on the East side, very thinne, chiefly oke and some small young birch.

(Rosier 1605)

It seems probable that the use of fire accompanied agriculture and fixed habitations as far north as the mouth of the Saco River. If we assume that the fires used to clear fields for planting occasionally escaped, we have to look for its influence up the valleys of the principal Maine rivers and as far northeastward as the Penobscot.

Historians and ecologists have assigned considerable importance to Indian fires along the southern New England coast (Trumbull 1797, Burnaby 1798, Dwight 1821, De Forest 1851, Hawes 1923, Bromley 1935, 1945, Walcott 1936, Colby 1941, Byers 1946). They are in general agreement that fires modified the species composition of upland forests and created extensive treeless or brush-free areas.

The outstanding dissent is that of Raup (1937). He believed that the early settlers, because of their European background, could not conceive of "open park-like woods growing naturally" and therefore assumed that the Indians had created them by fire. Actually, he pointed out, "Open, park-like woods have been, from time immemorial, characteristic of vast areas in North America. Almost anywhere one chooses to look on the periphery of the great arid plains of the interior of the continent he sees this savannah or park-land extensively developed." Raup cited no evidence for his assumption that the early settlers attributed the open woods to Indian fires because of an inability to imagine naturally open woods. Of the authorities cited in this paper, DeVries, Denton, Lindeström, Morton, Wood, Johnson, Williams, Van der Donck, and Kalm were in a position to see both the fires and their effect.

The existence of open woods on the periphery of the arid plains of the inter-

ior is not evidence for the existence of similar stands in the well-watered Northeast. There is, in fact, some question about how much of the open forest in central United States is natural and how much is the result of fire. There are many references to the creation first of open woods and finally of grassland by repeated fires and to thickets and woods which sprang up when burning was discontinued. A review of these references is beyond the scope of this paper, but attention may be called to Michaux (1803), who concluded that fire caused the "spacious meadows in Kentucky and Tennessee" and probably the plains of "Upper Louisiana and New Mexico"; to Shaler (1884) who believed that fire deforested the "prairie lands in Indiana and Illinois, and perhaps of more westerly regions"; and to Stewart (1951) who has suggested that even the tall-grass prairies may have been maintained by fires since early post-glacial times.

Information about Indian burning and other Indian activities is harder to obtain for the interior of New England than for the coastal region because hostilities postponed settlement of the interior. Dwight (1821) asserted that the oak, chestnut, and pitch pine land in New England had probably been burned for over a thousand years, but his authority is not apparent. He may have been influenced by the oak openings which he had seen in western New York. Hawes (1923) thought that the effect of Indian fire was slight except in the coastal region. Bromley (1935), using the Indian population figures of Gookin (1674) quoted by Dwight, concluded that there were enough Indians in southern New England to burn over annually most of the country that was dry enough to burn. He thought this comprised "most of the southern New England region, except the Berkshire, Taconic and possibly the hilly region of North Central Massachusetts." Raup (1937) considered inconceivable, a wholesale conflagration in Massachusetts, Rhode Island, Connecticut, and southern New York every year, reasoning that it would destroy

the undergrowth, herbaceous species, and animal life if not the forest itself. He cited Whitney's history of Worcester County, Massachusetts, which "makes very few references to fire of any kind." Byers (1946) pointed out that Whitney's book was published a hundred years after the country was settled and fifty years after the passing of a law forbidding burning. Worcester County, moreover, embraced the hilly region in which Bromley had doubted the influence of Indian fires. Other histories of interior Massachusetts towns mention Indian burning and the openness of the country. Temple's (Byers 1946) history of Brookfield stated that burning made travel by horseback feasible all through the district and that "From the top of Coy's hill cattle could be seen for a distance of three miles, and deer and wild turkeys a mile away." According to Judd (Byers 1946), the first settlers of Northampton, Hadley, and Hatfield found plenty of lowland ready for plowing and mowing and rather open homesites on higher ground, "In Philip's war and in later years companies of horsemen and larger bodies of foot soldiers seem to have penetrated the woods without difficulty in every direction. . . . When some of the people of Northampton petitioned for a plantation at Squaheag (Northfield) in 1671, they stated that the Indians had deserted the place, and that for want of inhabitants to burn the meadows and woods, the underwood had increased." Annoyance with this situation may have given rise to the laws requiring "everyman to work one day a year clearing brush from the highway." It seems that there is no evidence in the early authorities for the wholesale annual conflagration of southern New England which Raup found unacceptable but only burning "in those places where the *Indians* inhabit" (Wood 1634) and outside of swamps. Frequently the fires appear to have resembled the light prescribed burns now used in some forest types (Little and Moore 1945, 1949), and there is no question about the ability of such fires to modify species composition and to create a

parklike stand without destroying the herbaceous layer and the animal life. It was reported by DeVries (1655) that, in spite of burnings along the New Jersey coast, "the hills rise up full of pinetrees, which would serve as masts for ships."

In 1760, Burnaby (1798) was concerned about the protection of New Hampshire white pines from "that very destructive practice, taken from the Indians, of fire-hunting." Pierce's history of Winchester, New Hampshire (Hurd 1886) stated that prior to 1720 the Sqaheags cleared land by repeated fires and "kept quite large areas treeless for the purposes of cultivation." Recently Bromley (1945) has pieced together the ecological history of the former Hatchet Lake Reservation in the towns of Southbridge, Massachusetts, and Woodstock, Connecticut, "the last stand of Indian influence that had once been felt throughout southern New England." Bradford family tradition supplied a description of the area as it was about 1831 when the Reservation was abandoned: "the vegetation of this section was characterized by an open forest of oak, chestnut, and hickory on the slopes; white pine and hemlock in the swamps; and bushy plains and blueberry barrens on the overly drained acid-soil plateaus and hilltops." After Indian influence ceased, pine appeared on the upland.

The valleys of the Hudson River and upper Lake Champlain must be included in the area affected by Indian burnings. Van der Donck (1656) has left us a clear statement that the Indians of New Netherland regularly burned the woods in the fall and again in the spring to make hunting easier, to improve the growth of grass, and to surround game. He saw many such "bush burnings" scorch the bark of hardwoods without injuring them and go to the top of thick pine stands, especially in Rensselaerwyck about Fort Orange. Pownall's (1776) description of the pitch pine stand between Albany and Schenectady, which he saw between 1753 and 1759, strongly suggests a fire history. In 1749, Kalm attributed decrease in the ex-

tent of fir (spruce ?) forests in the vicinity of Crown Point to "the numerous fires which happen every year in the woods, through the carelessness of the Indians, who frequently make great fires when they are hunting, which spread over the fir woods when everything is dry" (Kalm 1770).

Fire was used by the Iroquois of central New York for hunting (Morgan 1904), for improving the growth of grass (Loskiel 1794), and for clearing fields (Parker 1910, Waugh 1916). Although there appear to be few early accounts of burning by the Iroquois, it is hard to explain in any other way the grasslands and open oak forests reported by Galinée (1875). Between Lake Ontario and the Seneca village near Victor, New York, the country was "for the most part beautiful, broad meadows, on which the grass is as tall as myself. In the spots where there are woods, these are oak plains, so open that one could easily run through them on horseback." Galinée also was told that this sort of country extended eastward three hundred miles and to the west and south an unknown distance, but it is very uncertain what his Iroquois informants meant to tell him. His Dutch interpreter knew Iroquois perfectly but French very little and later proved uncooperative. Brown (1943) believes that the Iroquois made large tracts of land treeless by their practice of firing the forest beyond their villages. This seems to be fully justified inasmuch as a number of travellers observed the "oak openings" of western New York about twenty-five years after the dispersal of the Iroquois. The appearance of openings near Batavia, New York, in 1805 was described by Bigelow (1876):

Hundreds of acres may be seen together, on which there is scarce a single tree, there being at most but an oak or a poplar or two, scattered at great distances. The earth here is covered with small willow bushes, brakes, butterfly plant . . . wild grass and strawberry vines, with very young trees not more than knee-high. In many of these open grounds, a man may be seen at a distance of two miles.

There are patches of trees interspersed among these open grounds. They are of the same kind as are to be met with in the neighboring country, and are of various extent. . . . Various conjectures are indulged as to the scarcity of trees; but the most probable is that it has been occasioned by the Indians repeatedly firing whatever would burn here. . . . What serves to confirm this opinion is the frequent appearance of charcoal and burnt sticks, and the abundance of young trees which are now shooting up. Wherever groves of trees are yet standing, it may be seen that they were probably protected by the interposition of a stream of water, or by the dampness of the soil where they grow.

Sutcliffe (1812) saw these areas in 1804–06 and thought that the Indians might have taken advantage of blowdowns and kept them clear by burning. Dwight (1821) saw them about the same time and agreed that fire was the probable cause. The marks of fire could be seen on older trees, and young trees were then springing up. At first, settlers thought the oak plains were inferior to adjacent maple land, but when sowed to wheat they produced more. Gordon (1940) has called attention to a modern example—a high terrace between Quaker Bridge and Onoville, New York, which according to the earliest surveyor's report, bore a pure stand of white pine, probably growing on an abandoned Indian cornfield. Repeated fires by Reservation Indians have since reduced it to a low growth of scrubby oaks and hickories.

Evidence for the deliberate use of fire by the Indians in northern New England and the Adirondacks seems to be lacking. It is noteworthy that Perrot (1864) described the use of fire for hunting buffalo on the prairies but does not mention its use for hunting moose and caribou in the North. Flannery (1939) thought fire-hunting was "not practical in inflammable forest country like the coniferous North," although we have seen that it was practiced in other inflammable forest regions. The usual incentives for burning, however, were lacking in northern New England and the Adirondacks: agriculture was less practiced; summer travel was by canoe rather than overland; winter travel

by snowshoes or on the ice was not hindered by underbrush; and deer hunting took the form of stalking or still-hunting rather than driving (Speck 1940). Only a few weeks after Kalm had described Indian burning at Crown Point, he noted that the Indians at the northern end of Lake Champlain were careful in their use of fire.

The natives usually make a fire during the night, both summer and winter, when they camp in the woods. One would think that as a result there would be many forest fires during the summer, but I was given to understand that although at times fires do start during the summer, it seldom happens, for the natives themselves are very careful to put out the fires wherever they have made them, inasmuch as it serves their own interest. If a fire should break out and destroy the forest and the vegetation, the roe deer would flee from this region with the result that their hunting would be much less successful.

Early descriptions of this region placed more stress on the thickness of the woods than on openings. For example, Josselyn (1672) called the country north of the White Mountains "daunting terrible, being full of rocky hills, as thick as mole-hills in a meadow, and clothed with infinite thick woods." Irving (1803) recorded that, while returning from New York's Black River country, "We were a great part of the time passing through thick woods the underwood being so thick as to prevent our seeing to any extent." Still it is hardly to be doubted that even in northern New England and northern New York, the pyric factor was present in the form of an occasional escaped camp fire and of lightning.

HUNTING CONTROLS

The influence of the biotic factor on plants has been clearly stated (Daubenmire 1947). The existence, if not the details, of a dynamic plant-animal inter-relationship is well-known, but the influence which the Indians exerted indirectly upon forest composition through their hunting activities has gone largely

unnoted. The writings of anthropologists (Speck 1915, 1931, 1938, Speck and Eiseley 1939, Cooper 1939, 1946, Hallowell 1949, Speck and Dexter 1951) give us considerable insight into the thoroughness of Indian control over the population in portions of the Northeastern woodland. Tribal land was divided into family hunting territories with definite boundaries. The proprietors of each territory knew intimately the plant and animal inventory therein, harvested the supply carefully with rituals of atonement and thanksgiving, and rotated their activities in such a way as to conserve the supply. We can hardly escape the conclusion that they maintained, as well as they were able, a balance favorable to their economy and that this was a different balance from that which would have obtained in an unpopulated country. No one seems to have attempted an evaluation of this factor on plant succession. In Bromley's (1945) observation that Indian burning in Massachusetts increased the food supply for heath hen, passenger pigeon, wild turkey and deer, the effect of animals is clearly secondary.

FAVORING FOOD AND MEDICINAL PLANTS

The Indian practice of favoring nut trees and other food plants was probably responsible for minor changes in the original forest. Bromley (1945) thought woods were burned partly for this purpose. Because nut-tree stands on village sites are usually even-aged, Baker (1950) advanced the theory that they originated when village establishment suddenly decimated the rodent population that planted the nuts. However, there appears to be an association of American chestnut, *Castanea dentata* (Marsh.) Borkh., groves and Indian village sites in lower Ontario, and Jury (1952) is inclined to the opinion that the trees were planted by the Indians. The Iroquois of New York planted the Canada plum, *Prunus nigra* Ait., and possibly Kentucky coffee tree, *Gymnocladus dioicus* (L.)

K. Koch, since it is most often found near village sites (Hedrick 1933).

Plants used by Indians for medicinal purposes may owe their existence in many localities to the transplanting hand of an Indian herbalist (Fenton 1942). Groundnut, *Apios tuberosa* Moench, and leek, *Allium tricoccum* Ait., were also cultivated (Hedrick 1933).

EVALUATING THE INFLUENCE OF INDIAN ACTIVITIES

We must conclude from the foregoing that the Indians of the Northeast cleared land for villages and fields, cut fuelwood and set fires beyond these clearings, exercised a wide indirect influence on vegetation through their hunting, and may have favored or even transplanted food and medicinal plants. These facts alone, however, are not very helpful in evaluating the extent and intensity of Indian influence in the Northeast or in reconstructing the history of a particular area. One needs rather full knowledge of four other factors which will be merely outlined in this paper—the duration of Indian occupation, the population density, population concentration and movements, and the local pattern of settlement or preferably the location of all village sites.

The peopling of North America began perhaps 25,000 years ago, but it did not take place uniformly and was not completed until rather late (Gladwin 1947). The age of archeological finds in the West has been placed at 6,000 to 10,000 years by radioactive carbon (Bell 1951). This kind of evidence does not seem to be available yet for the Northeast, but occupation of New England, New York, and New Jersey by a pre-Algonkian people began in very remote times (Parker 1920, Willoughby 1935). The entrance of the historic Algonkians and Iroquois into the Northeast has not been dated satisfactorily, but the Indians found in "Vinland" by the Norsemen about 1000 A.D. bore some resemblance to Algonkians (Haugen 1942). Indian traditions agree

that the land had been occupied for generations before the arrival of the white men (Hale 1883, Brinton 1885, Speck 1928).

We shall never know the population of the northeastern tribes in the sixteenth century, because the white man's acquaintance with them was preceded by his diseases and his disruption of the primitive economic patterns (Ruttenber 1872, Ashburn 1947, Hunt 1940). Early statistics are fragmentary; they contain much hearsay evidence. It may be suspected that they were sometimes colored by the motives of their reporters (Gallatin 1836, Bancroft 1885). Often the observers suffered from language difficulties with their Indian informants and from confusion in tribal nomenclature. Smith (1616), for example, admitted that he wrote not fully but "as I gathered from the niggardly relations in a broken language to my understanding."

Indian populations were often reported only as numbers of fighting-men. As hostility was almost continuous along the border, this practice is understandable, but it is another source of error. The fighting-men were variously estimated as one-third, one-fourth, one-fifth, one-sixth, and one-ninth of the total population (Lahontan 1703, Trumbull 1797, Dwight 1821, Tyron in O'Callaghan 1850, Beauchamp 1892, Thwaites 1896—Relation of 1657-8, Lloyd in Morgan 1904, Crockett 1921, Brown 1943). This is not the place to survey the rather extensive literature dealing with Indian numbers. The most complete enumeration is that of Mooney (1928), but it was frankly tentative and some errors are apparent. Ecologists may feel that procuring this information is properly an ethnologist's work, but the information is indispensable for understanding the ecological history of the Northeast or specific portions thereof.

Although family groups sometimes lived apart, the Northeastern Indian population characteristically congregated in villages which were moved seasonally or

at intervals of several years. Even the nomads of Labrador gathered in villages in the summer (Speck 1935). In northern New England, the Abnakis seem to have lived in villages part of the year (Speck 1940), while in southern New England, New York, and New Jersey a more agricultural population lived in villages of some permanence.

The villages of the Abnakis went through an annual cycle of migration—southward to seashore camps for the summer, northward to deep woods hunting camps in the fall and winter, returning to villages along the rivers for late fall feasting and spring fishing and planting. Apparently the seacoast and interior tribes of Connecticut made seasonal visits to each other's location, even exchanging residences altogether (DeForest 1851). The Lenâpé had a similar pattern of movement between seashore and interior in New Jersey (Philower n.d.).

Even the villages of agricultural tribes were moved at intervals as the soil declined in fertility, as the local supply of firewood became exhausted, as weed infestation of fields, scarcity of game, or trash and vermin made the site uninhabitable (Mather 1702, Lafitau 1724, Loskiel 1794, Beauchamp 1892, 1905, Parkman 1909a, Ganong in Champlain 1613-32, MacLeod 1936, Fenton 1940, Brown 1943). Other moves were dictated by military considerations (Champlain 1613-32, Fenton 1940).

Lafitau (1724) reported the frequency of these moves vaguely as "after a certain number of years" and Loskiel (1794) as "frequently." Other estimates agree fairly well. Champlain (1613-32) judged them to take place every 10, 20, or 30 years; Beauchamp (1905) every 10 or 15 years; and Fenton (1940) every 10 years and "about twice in a generation." These estimates are confirmed by the known locations in the village of Onondaga, which was near the present Syracuse, New York. As the federal capital of the Five Nations, who were feared and courted by both France and England for

over a century, Onondaga was often visited by missionaries, travellers, hostile expeditions, and political emissaries. It appears from their accounts that Onondaga occupied at least nine different sites between 1610 and 1780 (Hewitt 1928).

The tendency of the Indian population to congregate in villages and to migrate had a direct bearing upon its effectiveness as a disturber of the primal scene. It is clear that the village habit localized and intensified disturbances, while seasonal migrations and periodic relocating of villages widened their influence. It should be recognized, however, that these movements were not random. Seasonal migrations followed much the same course each year, and there was a tendency for desirable village sites to be reoccupied by the same tribe or by their conquerors.

There is no substitute for a complete knowledge of the archeology of an area in determining where Indian influence may have been operative, but our tentative conclusions may be improved by knowing the historic locations of the Indian population and the kinds of sites which were usually chosen for villages and fields. It is natural to assume that most villages were located along streams and bodies of water because of the importance of fish food and the fertility of alluvial soil. Indeed, Marsh (1885) thought these were the only village sites. Islands and land partly enclosed by stream confluences and meanders were sometimes chosen for defensive reasons. Defensive needs, however, often dictated hilltop locations. This was characteristic of prehistoric and proto-historic Iroquois villages (Fenton 1940) and probably of others. Kellogg found that village sites in the Lake Champlain Valley were often located "at a distance from any even moderately large body of water" (Crockett 1921).

While looking into the question of Indian disturbance, the writer has not emphasized the existence of large tracts of undisturbed forest. Their existence is generally accepted (Champlain 1613-32,

Smith 1616, Wood 1634, Josselyn 1672, 1675, Pownall 1776, Strachey 1849, Shaler 1884, Maxwell 1910, Hawes 1923, Willoughby 1935, Byers 1946, Bakeless 1950), although, as Gordon (1940) pointed out, it would be difficult to prove primeval status absolutely in any particular case. In fact, their existence and extent may have been accepted too readily. For example, when Hawes asserted that, "While the Indian fires may have affected the forests near the coast, there were undoubtedly great stretches of virgin forests unbroken except by the occasional river meadows," this may have been true, but we should not assume that it was true for a particular locality without a careful study of local archeology and history.

A good case in point is Vermont, which is customarily treated as having had no Indian population worth mentioning. Champlain thought that the Vermont shore of Lake Champlain was inhabited in 1609, but subsequent events indicate that he was probably mistaken. His informants may have been referring to recent transient occupation by the Iroquois. During the French and Indian wars, Vermont's position made it a no-man's land. Gallatin (1836) stated that "There do not appear to have been any tribes of any consequence in the northern part of New Hampshire, or in the State of Vermont." Ray (1943) asserted, "We know, indeed, that Vermont was wholly without aboriginal inhabitants." Gookin's (1674) editor commented that "The Indians were never numerous in Vermont." Bancroft (1885) wrote, "Vermont and northwestern Massachusetts and much of New Hampshire were solitudes." Palfrey (1882) ignored Vermont in his enumeration of the New England Indians, apparently following Gallatin. Parkman (1909a) claimed that Vermont "had no human tenants but the roving hunter or prowling warrior." Willoughby (1935) agreed "There seem to have been but few Indians in Vermont" at about the beginning of the seventeenth century. In Van de Water's

appraisal, there was an unbroken forest, virginal and empty, between Lake Champlain and the Connecticut River.

It would seem that here if anywhere the original forest should be free of anthropic influence. An ecologist in a hurry might so assume and in so doing would make a serious mistake. Crockett (1921) brought to light the little-known fact that Indians from southern New England and from Maine occupied parts of Vermont following their defeats in 1676 and 1680. The French maintained missions among them on Otter Creek and on the Winooski and Mississquoi Rivers until about 1760. There were permanent Squakheag and Mississik settlements in the extreme southeastern and northwestern corners of the state respectively, and there were intermittent settlements along the upper Connecticut River. The Mahicans repaired annually to the Walloomsac and Battenkill valleys. The Caughnawagas, after locating on the St. Lawrence River, hunted and trapped for decades west of the Green Mountains. After listing evidence of occupation in 29 Vermont townships, Crockett concluded that such evidence had doubtless been found in every township in Vermont. This should make the ecologist wary of supposedly uninhabited regions.

SUMMARY

The northeastern United States was occupied from remote times by an Indian population whose size has not been—and perhaps can never be—determined accurately. Most of this population lived in villages. These Indians created sizeable clearings for their villages and fields and probably expanded the clearings as they foraged incessantly for firewood and other necessary materials. Over much of the region, they set fire to the woods to improve travelling and visibility; to drive or enclose game; and to destroy "vermin." They probably exercised some influence on the forest through their control over the animals they hunted and through

planting food and medicinal plants. It is certain that their activities destroyed the forest in some places and it is hardly to be doubted that they modified it over much larger areas. Seasonal migrations and the periodic relocating of villages widened the range of Indian influence, which extended into unexpected localities and supposedly uninhabited regions.

We must conclude that an area which was wooded when first seen by white men was not necessarily primeval; that an area for which there is no record of cutting is not necessarily virgin; and that a knowledge of local archeology and history should be part of the ecologist's equipment.

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