THE UPLAND PASTURE

On barren upland pastures of Maine's coastal islands worn thin like threadbare carpets with all the nap gone, the bare ground is yet completely concealed from view: every square inch is covered by an assortment of specially adapted plants. By continuous extraction without replenishment stony, sterile fields long since abandoned for the pasturing of cows or sheep--pastures which even the thrifty New England farmer relinquished to the careless forces of nature--no longer offer a hope of remuneration for an investment in rejuvenation. But to the non-thrifty, to the casual disinterested visitor, they offer a great deal to see. These rocky slopes are usually edged with prostrate junipers waiting to move in. Prickly to bare ankles, they fill one's sneakers with sharp needles that must for comfort be shaken out after every bush that is waded through because there is no way around. The junipers thrive in these sun-flooded fields and will eventually fill them up, crowding out all the smaller plants, until they in turn are overshaded by the invading forest and die too from lack of light rather than lack of nutriment. Nutriments they find in plenty in this barren soil just as do the lesser things that preceded them.

Observed casually an upland pasture gives the impression of being sparsely inhabited, of supporting a mat of growth containing no tall plants or grasses. But enter the ground early on a dewy morning and one will be surprised how wet the feet become in the first few steps. Although hardly noticed until the burden of shining droplets each old stalk and spear of grass holds chills and dampens one's feet, they are seen then to be growing quite thickly, so close in fact it is impossible to take a step without brushing against them.

They grow like the first stubble beard of an adolescent boy, but they are the product of exhaustion not of youth. As these stalks and spears dry off in the morning sun, they vanish again into the confused background of matted vegetation.

Examine this floor closely and it will be seen that the vegetative cover is dominated by three varieties of plants, one primitive and two flowering types. They form a sort of patchwork of colors and shapes that solidly occupy much of the ground, but intermingle at the borders between the colonies of each species. The primitive plant is a bluish, gray-green, branching moss-like organism commonly called reindeer moss--not a true moss, however, but a symbiotic association belonging to that curious group the lichens. A lichen is a working arrangement between a single-celled alga and a fungus in which the concept of discrete individuals as it is understood to exist between, say, separate trees or flowering plants is quite meaningless. Reindeer moss is often seen covering a considerable area in a continuous growth, but its luxuriance is not in the least inhibited by cutting it up into distinct parcels provided its attachments to the ground are not radically disturbed. The algae and fungi which have entered into partnership in multitudinous combinations to produce the thousands of known lichens do not succeed very well by themselves under the environmental conditions that favor the growth of lichens. Separately they are especially vulnerable to extremes of dryness and temperature. The two varieties of green and blue-green algae that go to compose lichens do exist by themselves in damp places as on wet bark in boggy forests, but not so for the fungi, at least not as recognizable members of the partnership.

Lichens have been separated experimentally into their component organisms which have been independently cultivated, but no one has succeeded conclusively in recombining them into the original or any identifiable lichen. And so, how they ever got together in the first place, what fortuitous circumstances or genetic shuffling could have brought about this intergeneric match, is rather a mystery, but get together they did and the relationship proved to be a strikingly amicable one. Each symbiont performs its self-assigned functions in complete harmony with its own and the needs of the other. The alga contains green photosynthetic granules in which it manufactures carbohydrates from water and carbon dioxide. These carbohydrates are used as a fuel for the production of vitamins and other organic substances needed by both partners. The fungus builds a housing of a dense, resistant gelatinous material which provides physical protection for the algal cells and its own living tissues and conserves moisture. It also extracts mineral and simple organic nutriments from the substrate to which the lichen is attached. Fungi having no chlorophyll do not have access to the energy of the sun and are unable to manufacture all the organic substances they need as green plants do; they are classed as saprophytes which defines them as living only on dead or decaying organic matter. When they join with algae they establish an arrangement whereby the power of the latter to provide what they cannot themselves produce is accepted in exchange for dependence on a source of preformed organic foods. They provide the algae on their part with inorganic nutriments which they extract from the substrate, but they also, and perhaps even more importantly, provide support and protection against desiccation.

Lichens are able to withstand extremes of physical conditions which would

be fatal to other forms of life; they are able to endure prolonged periods of drying, baking by a tropical sun, and the frigid temperatures of mountain peaks and arctic wastes. Lichens are thought to be the initiators of soil building for they are the first colonizers of bare rock and barren ground. Protection against the rigors of their environment is obtained from the nearly impervious gelatinous armor in which they encase themselves. But within these walls the living cells of the algae and fungi further guard themselves against adversity by passing, in times of severe drought, into dormant, spore-like inactivity from which they are immediately aroused by the return of favorable growing conditions.

Wherever the air is clean and unpolluted lichens occur, but they are extremely vulnerable to industrial wastes and gases and have been killed off in most manufacturing regions. Under favorable conditions they may be found in crusty plaques of yellow, orange, blue, and brown attached to every conceivable kind of surface, to rocks and cliffs and canyon walls in shade and sun, to trunks of trees and branches, and on the forest floor. Cliffs exposed to salt sea air are splashed with bright orange lichens all along the coast of Maine. The pigments are produced by the fungus partner and have, since ancient times, been used as dyes. In forests leafy growths cover boulders and the bark of trees with loosely attached scaly patches, and in the gloomy recesses of rocky ravines a type called rock tripe grows in leathery, dark green, peeling sheets. Perhaps the most abundant and remarkable lichens are the filamentous types that cover large areas of the forest floor and arctic tundra with branching pale moss-like beds, springy when wet but which become brittle and crackly under foot as they dry out. These are Cladonias, the reindeer mosses. Another filamentous type, usnea or Old Man's Beard, which is also sometimes erroneously called a moss, hangs from

the branches of trees in long streamers. It occurs in great abundance in the northern fir forests of the eastern United States where some trees appear to be completely smothered by it, although it seems not to kill them. But it is found also wherever periods of fog provide the required moisture for intermittent growth as on the Pacific slope of the Baja California peninsula and in the Galapagos Islands that straddle the Equator. In all these varieties the fungus of the lichen absorbs the nutrient chemicals through root-like processes called rhizoids. Wherever the plant grows on bare rock the rhizoids excrete an organic acid which dissolves the stone making available the needed elements for growth, and at the same time they secure a firm attachment. When a lichen dies and its dried remains blow away a light-colored clean etched pattern remains to mark its size and position on the rock.

The reproduction of lichens is complicated by the duality of their structure. The most successful means adapted to their dispersal is vegetative reproduction: that is by the breaking off of small fragments of thallus which then are mechanically disseminated. Such fragments contain cells of both the alga and fungus partner, and can therefore withstand considerable periods of unfavorable growing conditions before they become lodged in a favorable situation. Another manner of reproduction is by spores of which two kinds are produced, both occurring in some lichens. Sexual spores are borne on fruiting bodies that develop on almost all the lichens as saucer-shaped or globular organs, often on stalks projecting above the thallus. The interior of the saucer or the surface of the globule is usually deeply pigmented in various colors or in black. One common kind of lichen found growing on rotting logs and forest litter is Cladonia cristatella related to the reindeer mosses. It produces short, branched, greenish stalks

each branch of which is capped with a deep red club-shaped fruiting body. The appearance is so striking that it has come to be called the Red Soldier lichen. The other type of spore is asexually produced by budding from the filamentous hyphae of the fungus. In the production of neither kind of spore are the algal cells involved; the spores ~~are~~ being purely fungal in origin. When cultivated on artificial media the spores develop not into lichens but into a dense amorphous structure composed of undifferentiated hyphae unlike any naturally occurring fungus. In nature, in order to reproduce the parent lichen, spores must germinate in intimate proximity with at least one cell of the right kind of alga, and although single-celled algae occur in free form in the soil and on bark and rock where the lichen grows, the chances of their meeting seem remote indeed. ~~And~~ The development of the symbiosis has never been observed. Laboratory attempts to synthesize a lichen have succeeded only in producing a mixed growth of the components without the symbiotic relationship developing. The characteristic morphology of a lichen bearing fruiting bodies has never been obtained. The factors that bring about the association remain a mystery, although mycologists have come to believe that they include starvation. Under cultural conditions the starvation factors have not yet been duplicated even though very suggestive effects have been observed which indicate that the alga of the partnership can profoundly alter the growth and adaptation of the fungus to its environment under adverse conditions.

The two commonest flowering plants that do well in barren Maine island fields are blueberries and hawkweed. The blueberry bushes of the kind found in New England are low-growing shrubs, seldom more than a few inches high, which have such tightly entangled woody stems and such small, densely arrayed, lanceolate leaves they exclude all other plants. In late May or early June before the

hawkweed has even begun to bloom the pink, panicled, bell-shaped blueberry flowers make their appearance. After a while the bells drop off leaving in their place tiny hard berries which gradually enlarge through June changing from green to pink and ultimately in July to powdery blue, turgid fruit, each with a little crown of sepals to mark the original point of attachment of the flower. ~~Everyone,~~ Every New Englander ~~at least~~, is familiar with blueberries, knows that when the bloom is rubbed off the underlying skin is a dark navy blue and contains all the dye of the berry, the pulp being almost colorless. He knows too the uses of blueberries, that between blueberries with cream or hot blueberry muffins for breakfast, and pie for supper the choice is not an easy one.

Hawkweed, the other common flower of these impoverished meadows, also crowds out grass but by different tactics. It spreads by runners on the surface of the ground from which at intervals leaves grow into a mat of flattened overlapping rosettes. The narrow leaves are bristly with white hairs that lie like bits of thread scattered over the rather dirty-green upper surface. From the center of each ~~swirl~~ whorl of leaves in June appears a hairy stalk, which grows to a height of half a foot or more and carries a single terminal bud that soon opens out into a flat yellow disc of square-ended petals like a little windmill. This is the Mouse-ear hawkweed ~~that~~ and differs from other hawkweeds found in damper locations by its small size, solitary blossom, and pale color. When in full flower these hawkweed beds give the field a uniformly speckled appearance. The blossoms seem to have been arranged with purposeful geometric precision, an impression which gains strength as they mature and all go to seed with marvelous unanimity. Then instead of yellow wheels the pasture is dotted with white puffy spheres that seem to float in a disconnected dancing layer above the

background of dark green leaves against which the stems of nearly equal length and similar color are rendered invisible. And then all at once following a night-time rain, or on a dewy morning, they disappear, wetted down and bedraggled, all airy lightness gone, irrecoverably ~~converted into~~ diminished to sodden gray ~~clumps.~~ ~~bollop~~ fibrous balls

Along the borders where junipers are advancing, under the sheltering edges of their spreading branches where moisture is conserved, in the spruce-green shade of the barrier forest margins, and in damp meadow hollows, true mosses, the Bryophytes, colonize as microforests of closely packed stems tufted with primitive tiny leaves. To look into a bed of moss is very much like looking down from an airplane onto the sea of evergreens of a northern forest, or at a mountainside of virgin redwoods. At fruiting time this similarity disappears as each miniature tree grows from its top a smooth golden rod tipped with a knob in which the sexual spores develop. The spore stalks resemble an array of golf clubs or the heads of long-necked birds; some are glaucous brown whereas others are dark with fuzzy hairs. From the shapes of these spore cases the common names of several of the mosses have been derived. Thus we have the Crane's-bill moss and the Hairy cap.

Not to mention the other kinds of vegetation scattered about, which give these scrappy fields color and variety, would be to give a false impression of their uniformity. More showy plants attract one's attention as summer advances. Beginning in June and continuing on into July two members of the snapdragon family bloom in rocky places: the more common is the familiar Butter and Eggs a short sturdy spike of yellow and orange flowers, the other a frailer plant of delicate branching structure bearing pale pink, lavender, and yellowish blos-

soms. Because of its thin, fragile, near invisibility on a rocky slope it has colloquially been called smoke flower.

Two kinds of roses bloom in July in the meadows and pastures, and on the beaches of coastal Maine. One is native, the other an exotic from Europe. The first, the common hardy meadow rose, is seen all over New England decorating fence rows and bushy pastures with delicate pink flowers that drop their petals soon after the buds open. The other, Rosa rugosa, is an escapee brought over from Holland and England by the first settlers. Its flowers come in deep pink and white, the leaves are dark green, wrinkled and shiny and the stems are bristly with sharp, needle-like thorns. On the islands of Maine it grows above the beaches in tall impenetrable thickets four to six feet high which are covered with a continuous crop of blossoms for two months during the summer, and when September comes around with bright red rose hips, which on being broken open reveal a mass of black seeds in a furry bed of whitish hairs. On impoverished land the rugosa roses are dwarfed by an inadequate supply of minerals leached away by rain, but which are found in abundance in proximity to the sea. Under the poorest conditions the plants may stand no more than six inches high but they bear flowers profusely, nevertheless. Spotted through stunted redtop grass, both varieties of roses contribute more to the beauty of a meadow than they do to the nutritiousness of the hay which until recent years was still mowed on many Maine islands. The thin grass envelops the dwarf bushes in a transparent veil of parallel stems conveying a visual sense of liquidity to the meadow through which the red roses loom like carelessly discarded submerged objects.

The less run-down meadows, if unattended and unmowed, ~~become~~ invaded by white daisies and a taller, more showy kind of hawkweed, which in some years

attains such abundance that it solidly gilds a field with a mixture of rich yellow and orange flowers. This delightful sight was the despair of island farmers--the only economic solution being to plow the whole field under before the flowers go to seed and to sow it in good timothy grass and clover. In late July, when the hawkweed has gone by, the turn for goldenrod comes around. Its various varieties ripen throughout the month of August and into September. One kind with a pyramidal head of flowers prefers a nearness to the sea where it grows on the beach heads in dense stands three or more feet tall. Another with a drooping head likes better the boggy borders of meadows, sharing these localities with steeplebush and meadowsweet; two wild spiraeas belonging to the rose family that bloom in August. No alder margin or hummocky pasture is complete without them, for they are as essential ingredients of the northern New England scene as brake and sweet fern and balsam fir.

But vegetation is not all that commands one's attention on these threadbare pastures. They also support an association of birds and voles and insects. Besides butterflies, which as a child I collected avidly in field and meadow, one of the most conspicuous insects found on young grass is a tiny creature which my brothers and I called a spit bug to describe the frothy bubbles the insect conceals itself under on green plant stems. Often of an early June morning meadow grass is flecked with these little globules of foam. The creature is not a true bug at all but belongs to the order of Homoptera wihch includes the cicadas, scale insects, and aphids. The common accepted name of the spit bug is froghopper. When the eggs, laid the summer before, hatch in the spring the green wingless larvae scarcely a quarter of an inch long select sites on juicy young plants and start sucking the sap. They blow bubbles of secreted mucus for concealment

and protection against drying out. After a short period of larval life the insect metamorphoses and emerges as a small winged adult which hops about on the vegetation as it feeds, thus justifying its name.

Where the grass grows less thinly, where each year's contribution still stands in dead tufts or collects in straw-dry clumps flattened by the winter's snows, there, amid the new green stalks of June that push through these past accumulations, Savanna sparrows hide their nests. And here too the meadow voles build their interlacing grass-lined tunnels deep from sight on the earth floor of the meadow. Savanna sparrows don't like the dry upland pastures ~~surrendered~~ to blueberry bushes and lichens containing little grass, and where the invasion by ~~juniper~~s is well under way. They are not adapted to this kind of environment, but two closely related birds are, the song sparrow and the white-throat. Both these birds may nest on the ground if they can find concealment under low spreading juniper branches or in the depths of a blueberry bush. Their nests are seldom visible from any point of view, especially from directly above. They may also build their nests above the ground in the thicker junipers where several layers of branches afford both support and a roof. These nests can be found by watching the birds to see where they go, ~~but are sometimes discovered~~ when one inadvertently flushes the bird from her eggs, and even on these occasions it may take one several minutes search to locate the nest, so well is it hidden.

Once nests are found they become landmarks for people who know about them, and who, if the nest is near a path, will make a circuit around it to avoid disturbing the birds. They are also, of course, centers of the pair's activities. Knowing where nests are makes the observation of breeding birds easier. You

may hear a song sparrow sing from a mullein stalk and, being an insider so to speak in respect to the family arrangements, you are able to say with assurance that the bird is advertizing his territory to other song sparrows, warning them to keep away from the nest you found the other day inthe blueberry bush nearby where his mate is nestled now, incubating a clutch of speckled eggs. And when the white-throat whistles from a spruce top in the evening you know he is there because his nest is in a juniper not Far out in the pasture ~~not far from his perch~~.