# The Maine Naturalist

## Journal of the Knox Academy of Arts and Sciences on the Fauna, Flora and Geology of Maine

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THE

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O Spring-time sweet!
Over the hills come thy lovely feet;
The earth's white mantle is cast away,
She clothes herself all in green today;
And the little flowers that hid from the cold
Are springing anew from the warm, fresh mold.

O Spring-time sweet!
The whole earth smiles thy coming to greet;
Our hearts to their inmost depths are stirred
By the first spring flower and the song of the bird;
Our sweet, strange feelings no room can find,
They wander like dreams through heart and mind.

—*Translated by James Freeman Clarke*

Photo by A. H. Norton

WILSON'S PETRELS

## DEPARTMENT OF ORNITHOLOGY

Editors { Arthur H. Norton, Portland
Prof, Alfred O. Gross, Brunswick

# OUR STORMY PETRELS.

By Arthur H. Norton.

Leach's Petrel, more commonly known on our coast as the Carey Chicken or corrupted to "Kerry Chicken," was until a few years after 1896, one of the most abundant seabirds to be found breeding on the coast of Maine. Its metropolis with us was within that archipelago between Pemaquid Point and the western extremity of Frenchman's Bay. Small colonies were found, however, as far to the southwestward as Casco Bay, from which it ranged eastward and northward even to Greenland.

Through the keeping of cats and dogs on these outer islands for the past quarter century, today this great population of birds has faded away, leaving us but a dangerously small remnant of a unique and most interesting species. The Petrels are pre-eminently sea birds, coming to land only for the purpose of nesting and raising their young, spending the rest of their lives at sea far from land, where their necessary activity during gales and storms won for them the reputation of being sacred to Mother Carey, a sea witch whose presence made visible by her feathered attendants was on such occasions most unwelcome to the superstitious seamen of olden days. The name Petrel is said to be derived from Petrellus (Latin for Little Peter), from the habit of many of the species of running with outspread wings on the surface of the water. Hence from their conspicuous activity during storms, the name of stormy Petrel, first applied in a generic sense to any of the small species, but later more or less restricted in the English language to one species, which is normally European in distribution.

Leach's Petrel, so named for Wm. E. Leach, is the only species of Petrel found breeding on the Atlantic coast of the United States. It is about eight inches long, of a sooty brown tint with white rump, and silvered tips and edges to the wing coverts; the legs are short, and the tail slightly forked.

It passes the winter at sea from the latitude of Virginia, southward to Brazil. In the spring the birds appear on the coast of Maine early in May, and late in the month they come to land for the purpose of breeding, visiting only the outermost islands off the coast. In their landing they are strictly nocturnal, making their appearance ashore only after twilight has deepened to dark night. The mated birds take possession of some dark recess among the rocks of a

sea or artificial stone wall, in a chamber of previous years' construction, or begin the excavation of a gallery in the soft earth, from one to two or rather more feet in length, enlarging the extremity and lining it well with a loose mass of dried grass, leaves, or more rarely, rootlets. In this saucer shaped nest, a single egg is laid. During the process of burrowing and nest building, both birds remain in the burrow during the daylight hours, but with the appearance of the egg one retires to the open sea, to pass the daylight far from land, returning at night to attend or relieve its mate. And during the long period of incubation, one of the birds is always to be found on the nest throughout the day; both sexes share in the duties of brooding.

When the young bird hatches, both parents retire to the open sea, coming ashore at night to attend the feeble young, which from the first is clothed with long woolly down of a uniform sooty shade.

Through the long period of adolescence, the young bird remains in the burrow, where it is carefully tended at night by its sea-roving parents. From the last of May well into September, while the breeding duties are in progress, the visitor to one of these large colonies throughout the daylight hours will never see a Petrel stirring. But when darkness shrouds land and sea, he seems transported to an ancient realm where spirits or personified forces again assume visible form and hold mysterious revels until dawn.

Here within Night's dominion in the midst of a no less funereally garbed throng of flitting forms, seeming to speak most earnestly in a subhuman, unknown tongue, which is answered by their encaverned mates in purring tones and pleading wails, the mind may readily picture a most animated gathering of the Black elves of old, hurrying to and fro for the accomplishment of some important mission, ere dreaded Day begins to ride his shining steed through the pathway of the sky.

The wide ranging birds from the sea have returned to land to relieve their brooding mates, and the air seems full of them, calling on every hand; the scene seems a hopeless chaos of activity, but soon by careful observation it is resolved to one of orderly purpose. As each flying bird passes over its nest, it calls in a hurried gibberish, to be answered by its brooding mate in an energetic purr often ending with a coaxing wail; the flying bird dashes on and swings away to leeward again coming up the wind, and again as it passes its nest calls as before to be answered again; time and again this is repeated, each passage over the nest finding the flying bird lower and lower in its flight, until it finally drops to the entrance of its burrow to meet its anxious mate. Now from the dank weeds and grass, like great June bugs others are rising or crawling to a convenient place to rise. One is in the very midst of their activities. From one's feet to

twenty feet overhead they swarm, often dashing against one's person in their haste.

But with the coming of the dawn, calm, damp and chill, this strange vision of the night has faded as a dream.

Though through the day these birds roam very far out at sea, at night many come well into the outer bays of the coast, where their presence is made known to those at sea by their very distinctive voices. Here they attend fishermen, and the splash of their feet alongside show that they are able to feed at night as well as by day.

The loss of this unique bird from among our breeding species would be most deplorable.

Off of our coast from early May to the middle of September another of these ocean dwellers is to be found often in abundance, and it is common the summer through after migration has ceased.

This is the Wilson's Petrel, named for Alexander Wilson, the so called father of American ornithology by no less of a person than Charles Lucian Bonaparte. Yet it is known to but few, the seafaring folk who meet it almost daily knowing it only as the "Kerry Chicken."

It is a smaller bird than the Leach's Petrel, having a length of seven inches; it is of a blackish hue, with white rump and silvered wing coverts like the last, but with a square tail, and long stilt-like legs, the feet being adorned with a lemon yellow area on their webs. Though so common off shore, it is never known to come to land except the few weaklings that are rarely driven inland by violent gales. Its flight is suggestive of that of a swallow: In calm weather the birds flit lightly near the surface of the water, frequently sweeping downward to run and seize some food, then resuming their graceful flight; but with the freshening breeze they face the wind, their activity increasing with the increasing gale, for these seeming frail birds must of necessity drive into the tempest. Yet, in the midst of its fury they are undaunted, now sweeping down to the water's surface to snatch some choice morsel, or poised on fluttering wings, run on its surface toward the dancing object, on its lee, perhaps whirling madly away to leeward, only to swing again into the wind and come up for another trial. On such occasions they seem to assemble from far and wide around seafaring vessels, perhaps attracted by the disturbance of creatures beneath the water brought to the surface by its passage, or perhaps for the alteration and eddies of air currents caused by its tossing hull. The scene is one of great animation, the active birds seeming to dance in joy on the most turbulent billows. It seems no wonder that such elfish creatures should have aroused the apprehensions of the superstition steeped generations of the past.

For years these little Petrels came with the summer season and

disappeared in the fall, just as our summer residents did, and still their breeding places were for years unknown.

It is true that when these birds appeared about the "Ripley," bearing Audubon on his voyage to Labrador, that the seamen who knew the Carey's Chickens only generally, told him that they bred abundantly on the Mud and Seal Islands off the coast of Nova Scotia, but these men had not distinguished the present bird from the Leach's Petrel which is the species breeding there.

In due course of time the present species was found breeding in the midst of the South Temperate Zone, and we now know that these small sea birds are only passing an antarctic winter in the mild northern summer.

## BIRD NOTES AND NEWS

In the last number of the AUK, for January, 1921, are to be found several articles bearing more or less fully on Maine birds: first that of Dr. Alfred O. Gross (one of the editors of this Journal), presenting the first installment of his intensive study of the Dickcissel; in this paper the records for Maine are summarized. The late Horace Wright presents an extensive study of the occurrence of the Bohemian Waxwing in New England, with several Maine reports previously unrecorded.

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Dr. Harry C. Oberholser maintains (correctly, we believe), that the Blue Jay of the northeastern United States, including Maine, requires a new sub-specific name, which is given as *Cyanocitta cristata bromia*. Mr. Ruthven Deane presents two new records of the occurrence in the State of the American Egret, together with a summary of its previous records, six in number, making eight for the State.

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The minutes of the recent Congress of the American Ornithologists' Union, held in Washington, D. C., November 8 to 11, 1920, show that twelve persons in Maine were elected to Associate membership in the Union; curiously, one of these was elected and has continued in membership since 1918. The Union is now represented in Maine by one Fellow, Mr. Nathan Clifford Brown, who is also one of its founders, two Members and twenty-seven Associates. Two Maine Members and five Associates have died.

Birdlore for November-December, 1920, shows that at the annual meeting of the National Association of Audubon Societies, held in

New York City October 25, 26, 1920, Mr. T. Gilbert Pearson was elected president to succeed William Dutcher, who died July 1, 1920. Mr. Pearson has served the Association as Secretary since its organization in 1904. Through his active experience no one could be better qualified for this important position than he, and with his genial, democratic personality, broad vision, and progressive spirit, keenness in analyzing new propositions and in reaching decisive conclusions, with the executive ability to organize and make a success of new plans, the continued efficiency and progress of this great organization is assured.

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Readers of this department are asked to co-operate with the editors of the *Maine Naturalist* through the contribution of notes and short articles, material for this department should be sent to Dr. A. O. Gross, Bowdoin College, Brunswick, Maine, or to Arthur H. Norton, Museum of Natural History, Portland, Maine. Such assistance will be appreciated both by the readers and by the editors.

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Lubec Bird Notes.—

As Mr. C. H. Clark had expressed doubts as to the presence of some species of summer birds here, out of justice to those who reported them, he took a ten-mile cross-country trip Sunday, and reports that he had the pleasure of seeing robins and hearing them in full song. One of them was so enthusiastic over the mild and spring-like day that he was caroling his April mating song.

A flock of *Colaptes auratus,* commonly known as "yellow-hammer," were feeding in a thinly wooded pasture. There is no previous record of this bird in the winter season.

Meadow larks are also in evidence, being the first winter occurrence since the mild winter of 1911-12, when the ground remained bare until Jan. 14 and again became bare the first of February.

It will no doubt interest those who are technical observers, to know that in a flock of the common chickadees Mr. Clark found one of the rare *Parus hudsonicus,* which is a chickadee having brown marking in place of the usual shiny black.

The golden-crowned kinglet was found in many wooded localities, and as active as in fly-time.—The (Lubec) *Herald* of Feb. 3.

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The Logcock in Warren.—

One lone individual of the Pileated Woodpecker was a two-days' visitor at the Knox Arboretum in South Warren, in the early part of the Winter. On each day when seen it was feeding on the ground under pines in company with Juncos. When approached, it flew up, uttering a peculiar whistling note, and alighted in trees nearby. During 35 years' residence here, this is the first Logcock that I have seen or heard.—N. W. Lermond.

The Ball Bird Conservation Club's record for the year 1920, of birds visiting Augusta and vicinity, was 152 species.

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Miss Carrie E. Miller, in her book "Birds of Lewiston and Vicinity," lists 161 species. This is a dainty little book of the author's careful records, personal observations and experiences, with an introduction by the late Professor J. Y. Stanton of Bates College. The beautiful frontispiece shows Prof. Stanton on the campus, with one of the College buildings in the background. "My natural ear," says Miss Miller in the preface, "is attuned to music, so many of my remarks will be on the songs of birds, for to me, as to John Burroughs, 'What is a bird without its song? It seems to me that I do not know a bird till I have heard its voice'." As Prof. Stanton remarks in the Introduction, "there is much more in Miss Miller's pamphlet than a mere catalogue of birds."

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## A RARE BIRD VISITOR TO MAINE.

Mrs. C. W. Alexander, President of the Ball Bird Conservation Club of Augusta, who has the honor of identifying a rare bird visitant to Hallowell last Fall as the Arkansas Kingbird, sends us the following clipping from the Kennebec Journal of Feb. 7:

"Probably the rarest bird to visit Maine during a long term of years, was the Arkansas Kingbird that appeared early in November, at the home of Mrs. B. F. Fuller, Middle Street, Hallowell. This species, generally known as the Western Kingbird, is a stranger east of the Mississippi, with but six records of appearance in New England, one of which was in Maine. Much interest has been manifested by bird organizations, and many thanks are due Mrs. Warren and Miss Miller of the Stanton Bird Club of Lewiston and Auburn for statistics from the *Auk Magazine*, which read as follows: "One taken by Mr. George E. Brown, at Elliott, Maine, in October, 1865, one by Mr. Frederick A. Kennard at Chatham, Mass., on October 20th, 1912, one by L. C. Jones, at Falmouth, Mass., on November 10th, 1918, now in the mounted collection of the Boston Society of Natural History. One long dead, picked up by Mr. D. L. Garrison at Marston's Mills, Cape Cod, on February 9th, 1920, one seen by Charles W. Townsend, M. D., at Ipswich, Mass., on September 19th, 1920, and one seen by Mr. Charles B. Floyd at Marblehead Neck, Mass., on November 20th, 1920." Mr. Floyd has been communicated with to make positive the identification of the Hallowell specimen, which had been observed by several members of the Ball Bird Conservation Club, who consider it a rare acquisition to the Club record.

The bird was last seen on Jan. 15th. Undoubtedly it has perished, as it was a fly catcher, and winters from Mexico to Guatemala.

MRS. C. W. ALEXANDER.

## DEPARTMENT OF MAMMALOGY

Editor { Alton H. Pope, Waterville, Me.

### OPPORTUNITIES FOR THE MAMMALOGIST IN MAINE.

In opening a department of mammalogy in this magazine, it is our aim to stimulate interest in all phases of the study of our local mammals. Maine has long been a favorite field for ornithology, and the literature of Maine birds compares not unfavorably with that of other states. In mammalogy what a contrast! Hardly a complete collection of local mammals exists in the state, and the only literature consists of articles and reports, chiefly the work of visiting naturalists. The larger mammals are well represented in the State Museum at Augusta, the smaller forms in the Bowdoin College collection at Brunswick, but such private collections as there are could be counted on the fingers of one hand.

As a basis for accurate study, at least one complete collection of local mammals should be maintained which might be used for reference purposes in further work on distribution. Sufficient collecting has already been done to show that the smaller mammals faunal zones similar to those mapped by Knight in his "Birds of Maine." Much more intensive work is needed to define the limits of such zones, and especially to trace the incursion of one or two southern forms which have recently appeared in York and Cumberland counties. In fact, changes in distribution due to such modifications of environment as the cutting of the forests and the cultivation of the land, offer some of the most fascinating problems for the mammalogist of today.

An even greater field, as yet practically untouched, is the study of life histories of local mammals. Habits of the larger species are tolerably well known, but one has only to attempt a complete life history of a deer mouse to find how smattering is his knowledge of such subjects as habitat, range, breeding habits, and economic importance. Inter-relationships of species are practically unknown. In his "Mammalian Life-Histories," Taylor says: "Few lines of inquiry possess greater interest and attractiveness than that which deals with the normal activities of the wild animal in its natural environment. Such studies also have a very practical value. The resulting data are often essential to the solution of problems in the prevention and control of animal-borne diseases, in the conservation of natural resources, in the elimination of waste, and the stimulation of production in the several branches of agriculture, including general farming, horticulture, grazing, and forestry. Not a single

farm product but is affected directly or indirectly by some animal activity * * *." Space is too limited to go into methods of study of life-histories here, but the interested reader will find many practical suggestions in the pamphlet above quoted.

In connection with field studies, much laboratory investigation is needed. In dealing with wild animals in confinement, due allowance must be made for abnormality of surroundings, but it is sometimes possible to determine particular points, as in breeding habits, which could rarely be observed in the free state. Paleontology is a branch of mammalogy as yet almost untouched in Maine, but the discovery of a fossil mink on our coast at least suggests possibilities for the student in that field.

Absorbing as these aspects are for the scientific student, it is the appeal of wild animal life to the appreciative observer that we must finally consider. Bird study, though in some cases a fad, has persisted because of the inherent attraction of living things to the normal, healthy person. In the same spirit will mammalogy draw its quota of devotees. Not primarily because of the value of the animals to man, not wholly to determine questions of fact, but essentially for the deeper appreciation of all nature which such a vital study brings.

For the mass of our information about mammals, we must depend upon the scattered observations of the hunter, the trapper, and the interested observer. Incomplete as these must be, they are, if accurate, our sole dependence in some particulars and when correlated become valuable additions to the sum of our present knowledge. For such notes, comparisons and comments, our columns are open, and it is earnestly hoped that all interested will avail themselves of this opportunity to publish their observations and experiences with native mammals. Photographs, if clear and pertinent, are especially desired.

A. S. Pope.

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Kansas has 80 species of wild mammals; Nebraska 94; Colorado 152; Texas 182; and California 369. How many has Maine? Let each Nature student send in a list of those they have seen. To the one sending in the largest correct list, with localities where each species was seen, we will give a year's subscription to this journal: or, if already a subscriber, we will give this person one dollar in cash.

# FACTORS AFFECTING THE DISTRIBUTION OF GAME ANIMALS IN MAINE.

THOMAS A. JAMES.

"Are our wild animals disappearing?" is a question often asked. The question is generally answered offhand, negative or affirmative, according to conditions as they appear at that time and place. Generally speaking, it is safe to say that our wild animals in Maine are not as numerous as they were a century ago, but conditions concerning the existence of all wild life has materially changed, even during the past fifty years, so that we must view the situation from different angles as years roll by. In Maine a century ago we read that our forests were filled with moose and deer, and our lakes, ponds and streams with waterfowl and fish; yet we also read of suffering and starvation among the early settlers, which may lead us to believe that at certain times and places food animals were as scarce as they are today. One thing is certain, man was not so well equipped as he is today with means for securing his food supply. But to offset that handicap to some extent, there were no laws to prevent him from taking a supply at any time and by any method that suited his fancy.

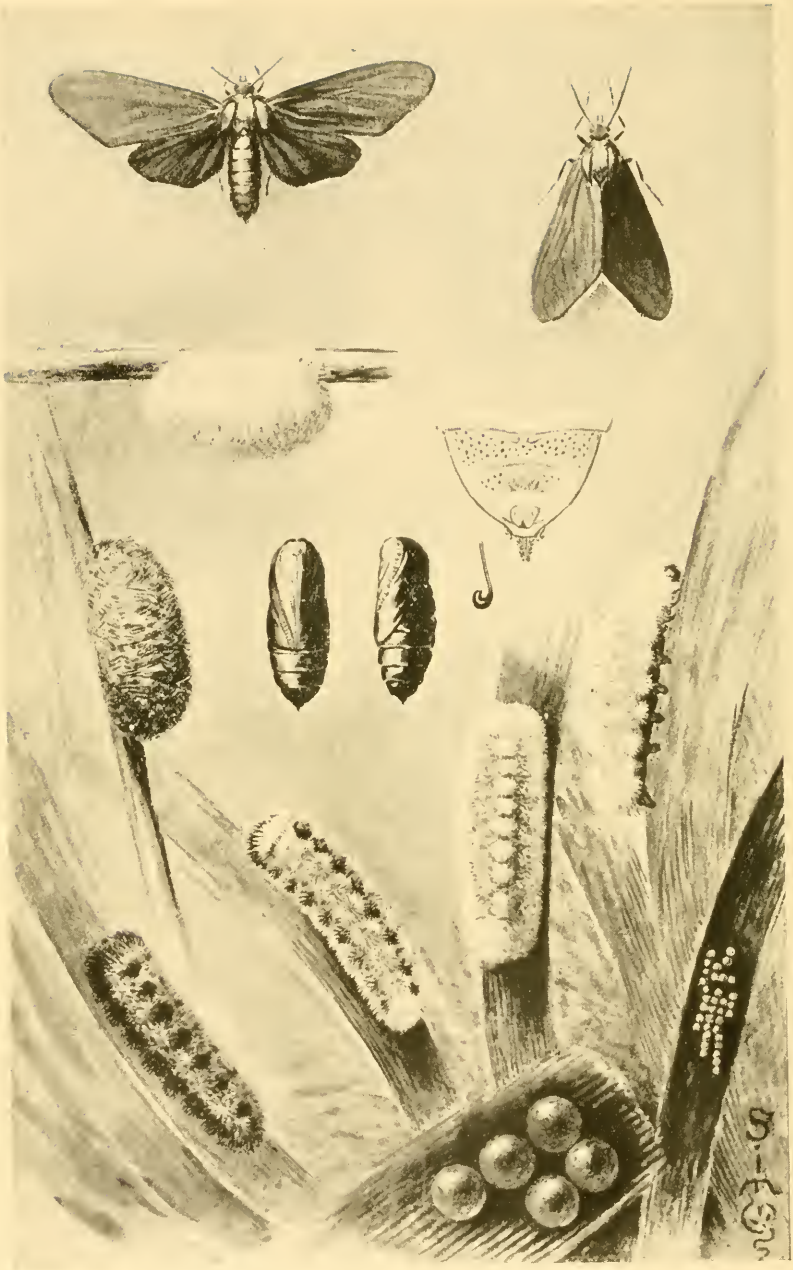
During the early part of the 18th Century the human race was so sparsely settled through the northern part of the State as to have small effect on the wild life, so that the game and food animals were kept in check by another factor, namely, the carnivorous fur-bearing animals. Among the worst enemies of game were the wolf, fisher, lynx, bear and fox. But when the human race began to settle in our forests, and towns and villages sprang into existence, we find that the fur-bearers suffered most, as the outside world was in need of furs, and the settler needed only enough food animals for himself and family. Therefore, for a time, the game showed an increase. Later, as transportation facilities improved, the villages and towns became cities and the call of the wild brought the city dweller to the forest for recreation and a winter supply of food; and in a few years the game supply in the most accessible forests began to show a decrease, so that in 1880 laws were enacted restricting the killing of game animals.

Another important factor concerning the life of our game animals was the lumbering operations. Many people think that cutting the virgin forests deprived the deer, moose and caribou of their food, thereby causing them to migrate to other localities. While this may be the case in some instances, I think more often the effect of losing

their shelter in winter and making more congenial surroundings for their enemies, the bear, lynx, etc., amongst the dead tree-tops and underbrush, is the real cause for their migration.

The writer remembers twenty years ago while moose were numerous in the northern counties of the State, they were almost unheard of in our southern and middle counties, but today they are becoming fairly well distributed throughout some of our southern counties where good forest cover is afforded them. We also find, where moose have appeared within a few years in a new locality, that the females are in the large majority, which leads us to believe the killing off of the mature males for the past twenty-five years has resulted in the females seeking new fields in search of mates. It is generally conceded that the moose race has deteriorated physically in the past few years, which I believe is due entirely to inbreeding. When vigorous males were numerous, a young male must prove himself a master or be driven from his mother's side to wander perhaps a year or two alone, until he could win a fight in another family and become ruler, and it must take many years of protection before the race can again become bred to its standard of twenty-five years ago.

Regarding the deer family, we find different factors that enter into their existence from those that concern the moose, and it has been claimed that moose and deer will not thrive in the same locality; but I think that is more a matter of food than enmity between the different animals. In summer, the moose feed largely on aquatic plants, by wading the streams and ponds, while the deer feed mainly on twigs, both of deciduous trees and cedars, and during the winter when the snow permits of travel, their favorite feeding places are the green tops of lumbering operations. In winter moose, too, must browse, so there is probably actual competition for food when both occur in the same locality. Deer seem to enjoy the more open country and smaller wood lots, if unmolested, and therefore have become well distributed throughout the State; but the great hindrance to the welfare and increase are the lynx and hunting hounds. We often hear of adult deer that have been killed by the lynx during the summer months. These conditions are more noticeable in the northern counties, while in the agricultural sections we may hear any day during the summer hounds baying in the woods, which has a tendency to keep the deer moving, so that many fawns, if not killed by these dogs, are left to starve by desertion by the parent. I believe that a campaign of education should be started along the lines of wild life protection. If this can be done intelligently, coupled with sane laws, well enforced, concerning all wild life, I believe that our game animals may exist and increase so that we may pass along to our children and their children more game than exists today. Our wild life in Maine is a great asset, both from a sentimental as well as an economic standpoint, and we of today must see that this great wealth is not squandered.



CTENUCHA VIRGINICA

# DEPARTMENT OF ENTOMOLOGY

Editor { Edith M. Patch, Orono

## A WINTER CATERPILLAR IN MAINE.*

By Edith M. Patch.

Wandering adventurously over the snow in early spring, or during thaw spells in winter, a caterpillar, clothed in a hairy coat of black and yellow, challenges the interest of those who meet him; for it seems as if a traveler from the tropics had somehow been stranded in the snows of Maine, and we wonder how he will fare. It is indeed in the heat of equatorial America that most of his family** are nurtured, but he, hardy creature, in spite of appearances, is no chance guest, but a native of Maine, enured to what hardships our climate imposes.

Stiff and inactive, he hibernates through the winter, unless roused by an unseasonable thaw that tricks him with a mistimed appetite for a meal; but not until the first blades of spring grass invite him is he permitted to break his fast of many months. He then grows steadily, though slowly, and undergoes the ordeal of molting twice before he is ready for the cocoon. Perhaps nowhere in the wide realm of life are the problems of growth more wonderfully worked out than with the six-footed creatures known as insects or hexapods; and the molt of our grass caterpillar is worth thoughtful observation. We find him in mid-April or later resting on a dry stubble, head down, usually, and quiet. The hooks of his creeping "false" feet are tangled in the thin silken molting mat he has previously spun over the surface of his support. His six "true" feet are held up near his head in a prayerful attitude. The segment behind his head is bulged out as if a second head had been crowded back under the skin there. That, indeed, is just what has happened, for the visible head is now but a nearly empty skull from which a newly formed head is being withdrawn, too large to be contained within the old skull and therefore pushed back into the skin behind the head—giving the larva a swollen "neck." To anyone with a nice sympathy for caterpillars, there is something pitiable about such a plight. For plight it is to be equipped with two heads and able to use neither,—to fast in spite

* *Ctenucha virginica.*

** Syntomidæ. Amotidæ. Zygænidæ.

Note.—This insect because it can be watched in the spring and fall, while school is in session, is a favorable species for nature study in Maine; and because the cocoon and the moth stage reach into the summer months, it offers a vacation amusement for such children as really become interested in its career during the spring. A bulletin concerned with its economic status is in preparation at the Maine Agricultural Experiment Station.

of two sets of mouthparts because one has lost connection with muscles and the other is imprisoned.

The strain of the new head within the old neck band, however, at last tells. A quick rip around the "collar," and the old skull has lost its connection with the skin behind it and the new head has popped out through the hole. After that the molt is soon over, six new "true" feet follow the head through the aperture, five pairs of new "false" feet are withdrawn from their respective stockings and a new creature walks down the stubble, leaving behind him, upon the molting mat, his discarded skin,—a shrunken, headless semblance of his former self.

The overwintering garment was set with black and yellow hairs, the yellow not being a fast color, fading to a dingy straw tone before spring; and all the other overwintering individuals of his species were like him. But with the spring molt, such differences appear as to make these caterpillars good material for a study in variation. After the mid-April molt some individuals are still black and yellow, practically, only a larger and fresher edition of the overwintering style; some have the hair-tufts along the sides of the body white instead of black; and some have these tufts mixed black and white, and are consequently grayish in appearance; all, so far as my own collections have shown, retain at this time the row of eight black tufts extending along the middle of the back. Later, however, another molt takes place, and with it is manifested even a greater variation in these caterpillars. Some are still black and yellow, and the sprinkling of yellow may be so slight that the caterpillar is nearly black; others have the black entirely replaced by white hairs, even to the mid dorsal tufts; and between the darkest color varieties and the palest blondes (the most beautiful of these caterpillars) are all gradations of black and white, though all preserve some yellow along each side of the dorsal tufts regardless of whether these tufts be jet black or snow white. The skin beneath the hair is subject to no such variation, and in this stage, the ten "false" feet are always wine-red, the six "true" feet are always black and the head always wine-red with a black face.

Between the middle of May and early June, fewer and fewer of these caterpillars are to be seen. Instead, we find an increasing number of black and yellow, black and white and yellow, and white and yellow objects along the grassy roadside or at the meadow margins. These objects attached to stubble or bush-stem or post or board or wire or any other convenient support, are the cocoons of our grass-eating caterpillars and vary in shade according to the complexion of the artists that fashioned them.

I say "artist" with a deliberate admiration for the creature that, without practice, weaves a structure so perfect. Any human, elated with the pride of construction and pleased when (with models for

comparison and tardy skill wrung from much practice) the basket is finished, a triumph in "arts and crafts" or "domestic art"—any human would do well humbly to watch one inexperienced caterpillar weave one cocoon. Any of the spinning species will serve this purpose; but because most of them are soon hidden within an outer layer which they construct first the whole process seldom can be followed. Our grass caterpillar, however, has a different method and can be watched until the cocoon is almost completed.

He is not critical as to the slope of the foundation against which his masterpiece is to rest. Whether it be horizontal, vertical or any angle between, seems a matter of indifference to him. An individual, therefore, who has selected the lower edge of a fence board may as well be chosen as any for the convenience of description.

He first makes, with the silk which drools from the spinneret in his mouth, a thin mat about his own length. Clinging to this by the hooks of his "false" feet, he works, back down, at the sides and ends of the cocoon which, after a deal of patient labor, outline a shallow oval with the edges about evenly woven down to perhaps an eighth of an inch. The fabric that he weaves, unlike that of many species, has but little silk in it, for his cocoon is chiefly of hair-cloth. Now that the framework is well started, it is easier to watch him as he clings, still back down, weaving, with warp of hair and weft of silk, his flawless cloth. The source of his silk, a liquid stiffened by the first air that touches it, has been indicated, but whence the hairy warp that composes the heavier part of the texture? Look—he swings the first few segments of his body to one side, and reaching back with his head, grasps a mouthful of hair close to his skin, and pulls. The wisp secured, he swings his head back to the cocoon edge and tucks it endwise into the entangling silk, giving it a tug which anchors it by the barbs on the hair. Then throwing his newly spun silk in and out, he weaves the filmy weft that holds the hairy warp in place.

After he has worked the cocoon edge down to the fairly even width of about one-eighth of an inch, he weaves longer at one place, devoting himself for some time to one curved end before, with cautious creep, he turns him right about face and weaves concavely at the other end. Plucking the hair from his skin, mouthful by mouthful, putting each wisp into place and winding it with new spun silk, he weaves his flawless blanket, shaping it into a sleeping bag as he works. He labors without waste of time or material and with no false moves. When spinning and weaving at the right of him he pulls out hair from the right side of his body, not reaching to the left for his supply. He grasps his little bundle of hair in such a way that it can be poked into place in the cocoon edge and tugged tight with a deft in and out motion, without shifting his hold on it—uprooting it from his skin and embedding it in the cocoon edge with-

out laying it down and picking it up again. When the ends are evenly rounded and the sides curved to the proper depth, he draws the edges and weaves them together without a seam.

So nicely has he regulated his supply to his needs that the hairs of his coat have just sufficed for the finished cocoon. He has toiled with a thrift so admirable that the old coat, no longer needed, has been remade into a sleeping bag, with no more than a few spears left over for scraps. He is now naked as a plucked fowl and reduced like a shorn poodle.

When we consider that this perfectly formed object, is the first and only cocoon of the caterpillar,—that he has fashioned it without model or experiment or experience or instruction, it gives us pause in our own conceit; and we wonder whether conscious intelligence is so superior to "instinct" as some of us have been prone to think, or whether that structure fashioned by the inherited genius of the caterpillar is not in some respects far more wonderful than measured garment or raffia basket of human construction.

His task over, his cocoon completed, our caterpillar relaxes the hold of his "false" feet and lies limp and waiting. He is no longer artist and weaver, but a helpless creature biding his time until the convulsions of molting shall seize him again.

While he waits he is shaped anew within, but when the strained skin ruptures (this time not around the collar line, but in a tear down the back along the three segments nearest the head) it is not a fresh caterpillar that creeps forth; but a soft, wriggling object with six legs, much longer than those he had before; wing-pads, quivering; a long straight tongue, with a groping motion; and two antennae. For he is now a new-born pupa, bright reddish for awhile with creamy yellow spots that show where tufts of hair had been rooted before they were plucked out, and wine-red lumps that indicate the false feet recently pulled from their last five-pairs of stockings. His new appendages move feebly for a minute or two but they are useless to him yet and are almost immediately glued fast to his body by the fluid which has enabled him to slip out of his shorn skin and which hardens on contact with the air in the cocoon. The dappled red and cream coloring gives way in a few hours to the hard varnished "pupa-brown" common to most kinds of moths.

After about sixteen days of external quiet and internal reorganization, another molt is experienced—the last our insect undergoes, for when the pupal shell cracks the emerging creature has completed its metamorphosis, and comes forth from the cocoon entirely transformed.

Many moths lead careers of less interest than those of the caterpillars that precede them; but our old acquaintance, in his new personality, does not disappoint us. For, although he no longer molts or weaves, he still has a way of his own, points of distinction which hold our interest. For one thing, he has forsaken the night, which masters most of the moth multitude, and seeks the sunshine.

And there we will leave him (dusky of wing and shimmering peacock-blue of body, with orange "shoulder" straps and orange bangs) to seek his nectar and to pursue his life—the summer incarnation of the hardy little being that walked across the melting snows of Maine.

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How many species of Coleoptera (beetles) find a home here in Maine? No one can yet give any very definite answer to this question, since no complete, or anywhere near complete, collection of Maine beetles has ever been brought together. This is only one of many questions in relation to our Maine fauna that the Knox Academy proposes in time to answer. Help us answer this one by sending in specimens, with date and exact locality, when and where taken. If you have a collection of beetles, please send us a list of species.

## DEPARTMENT OF MARINE BIOLOGY

Editors { Prof. C. H. Batchelder, Orono
Dr. Edwin Gould, M. D., Rockland

### SOME OBSERVATIONS ON THE GRAY-FISH.

By Edwin W. Gould, M. D.

At the annual meeting of the Knox Academy of Arts and Sciences, held Jan. 8th, 1921, in the Rockland High School building, Dr. E. W. Gould, senior member of the Sea and Shores Fisheries Commission, gave a very interesting address on the Grayfish, known by our fishermen as the Dogfish.

Dr. Gould spoke at the outset of the widespread prejudice against this fish as an article of food, presumably because in its annual visitation to the coast of Maine in large numbers, it is regarded as a pest, and the same way along other coasts, very destructive to fishing gear and cordially hated by the fishermen. He said that they were beyond doubt a valuable food, very appetizing when cooked in various ways, soon after being taken, but as yet no satisfactory method has been discovered of canning them so that they would retain the clean, fresh taste for many months. The by-products are so many and varied that they open up a broad field for investigation, one that merits the closest attention and scientific experimentation.

Touching upon the life history of the fish, he said:

Very little is known of the life history of the grayfish, with exceedingly scant literature on this so much maligned member of the fish family. It is known with some degree of certainty that from some unknown locality in the depths of the ocean they begin their migration to the coastal waters about the last of the month of June, and are first taken along the inner bank of the Gulf Stream, from there they continue on their journey of migration until the coast is reached, where they remain until cold weather approaches, when they depart for parts unknown. This is not an invariable rule, as these fish have been observed on the coast nearly if not quite all winter.

A most interesting phenomena is observed in the birth of grayfish. That is, the so called egg and its final disposition. To the uninformed the term egg in connection with grayfish conveys the impression that grayfish are hatched from the egg. As a matter of fact, the so called grayfish egg is a food pouch or capsule, is nearly as large as a common hen's egg, of pale yellow color that reminds one of the yolk of egg; the tunic capsule is composed of a strong, fibrous, nearly transparent tissue. The contents of this sac is a concentrated, highly nutritious, pre-digested food. The embryo grayfish,

snugly ensconced in his retreat, patiently awaits the summons to begin the struggle for a separate, and independent, existence. No thought of food is entertained; life appears to be a period of rest, when suddenly, without warning, he is thrust forth with scant ceremony, given his inheritance at birth, and that he may not squander his birthright, the food pouch, it is firmly attached to his body, near the anal opening, and hangs pendant, trailing along as he swims, a distinct but necessary encumbrance. Must he continue through the cycle of life, thus handicapped, with the carrying of this ever present appendage, a constant danger when pursued by enemies? Let us investigate this obstacle to swift motion, of what does it consist, why cannot the fish exist without this impediment? What is the function of this golden pedunculated sphere? It is soft to the touch, the surface is smooth and shiny, and has the external appearance of an egg without the hard shell. We will rupture this sac and ascertain what is contained therein, a tiny slit will suffice, and then an outpouring of a pale, lemon yellow substance, of the consistency of cream, with a sickish, sweet odor, with a fishy taste not unlike fried halibut, with the feel of small granular particles on the tongue. Here we have exemplified one of the wonderful provisions of nature, a small, immature fish some five inches in length, hampered in its movements with a large sac-like appendage, a fish with the appendage of the skin only partially developed (by the appendage of the skin of fish we mean the scales and teeth). As before stated, the sac contains predigested food that is absorbed to sustain the young grayfish until his teeth are developed to a degree that will enable him to secure food.

# DEPARTMENT OF BOTANY

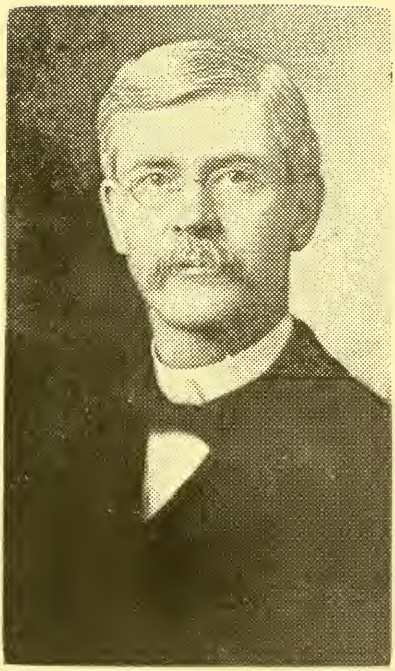
Editor { Louise H. Coburn, Skowhegan

## THE JOSSELYN BOTANICAL SOCIETY OF MAINE.

By Louise H. Coburn.

In July, 1895, a group of botanists and plant-lovers from different parts of the State gathered in the rooms of the Portland Society of Natural History and organized the Josselyn Botanical Society of Maine. The first suggestion of the Society came from Mrs. H. K. Morrell of Gardiner, while to Prof. Merritt L. Fernald, a native of Orono, at that time just beginning his distinguished career at Harvard University, must be awarded the credit and perhaps also the responsibility of actually organizing it, and of carrying it largely by his own effort and enthusiasm through its early years. The name was suggested by Prof. Fernald, and was taken from the name of the first man to make something of a study of Maine plants. This was John Josselyn, who in the seventeenth century spent some time on our coast in the town of Scarboro, and in his book entitled "New England's Rarities Discovered: in Birds, Beasts, Fishes, Serpents and Plants of that Country," published in London in 1672, gave the first account on record of plant life in what is now the State of Maine. Prof. Asa L. Lane of Coburn Classical Institute, Waterville, was the first president of the Josselyn Society, and Merritt L. Fernald the first secretary.

The society has held a summer meeting in June, July or August every year since its beginning, except in the war year 1918, and two winter meetings have been held in Portland, making a total of 27 meetings, including the one for organization, in the quarter century of its history. There were 72 charter members, and there is a present membership of 60. The attendance at meetings has averaged between a dozen and 25, with one or two falling below the smaller, and a few exceeding the larger number. The meetings have been held in all sections of the State, sometimes in the central part, as Waterville, Dover, Gardiner, Skowhegan, and Farmington, or in the southern, as Brunswick and Shapleigh, but oftener on the coast, as Kittery, Wells, Peaks Island, Thomaston, Manset and Machias, in the forest country, as Pleasant Ridge Plantation, Jackman, Kingfield and Greenville, among the hills, as in Oxford, or on the border, as Fort Kent, Van Buren, Houlton, Parsonsfield and Fryeburg, where the hope would be entertained of finding new and interesting floral conditions, and of adding to the Maine list of plants. Van Buren at one border, Kittery at another, and Fryeburg at still another represent the extremes of our pilgrimages.



By Courtesy Evening Express Pub. Co.

DR. DANA W. FELLOWS

President of the Josselyn Botanical Society of Maine

Most of the Josselyn members are amateurs, but there are always enough experts to lead the expeditions, and give advice and assistance to beginners. Helpful members in the earlier years were our quiet and courteous first president, Mr. Lane, Miss Kate Furbish, who has made Maine botany a life study, and whose energy and enthusiasm never flagged as long as health permitted her to attend, Prof. Leslie A. Lee of Bowdoin College, who took great interest in the Society and attended whenever possible, Mr. and Mrs. Ora W. Knight, interested in many kinds of natural history, Mrs. G. D. B. Pepper, a true lover of all growing things, Rev. B. P. Snow, and others.

It has been the custom to spend about four days at the selected spot. In the earlier years it was usual to divide the days between indoor meetings and field excursions. Later the call of the open was heard more loudly, and all the days were given to the field, leaving evenings for business meetings, and one or two botanical papers or talks. Among the many botanists who have had part in the programs have been Prof. J. Franklin Collins of Brown University and Mr. Edward B. Chamberlain on the subject of mosses, Dr. Lincoln W. Riddle of Wellesley College and Mr. George K. Merrill on lichens, Prof. A. B. Seymour on fungi, Mr. A. A. Eaton and Dr. Dana W. Fellows on ferns, Rev. A. B. Hervey and Mr. Frank S. Collins on marine algae, Mr. Austin Carey on forestry, Miss Kate Furbish and Prof. Fernald on plant distribution. Prof. Fernald, who knows more about Maine plants than any person who lives or ever did live, has never failed when present to give a talk illustrated with herbarium sheets about the special flora of the region being visited, or plants recently added to the Maine list, or some other immediately appropriate topic.

The Society counts in its membership a number of persons living outside the State, most of whom were born in Maine, like Prof. J. Franklin Collins, Mr. E. B. Chamberlain, Mr. Clarence H Knowlton, Mr. and Mrs. Ralph C. Bean, Dr Susan P. Nichols of Oberlin College, and Prof. Fernald. Others are interested in Maine botany through summers spent here, like Mr. Edward L. Rand, author of the Flora of Mt. Desert Island.

Nor is the interest of the Josselyn excursions confined entirely to botany. One member is Mr. James H. Emerton, the specialist on spiders, who has been a frequent attendant at the meetings. There is always someone, like Mr. A. H. Norton of the Portland Society of Natural History, who is acquainted with birds, and who, when in the deep woods in the Dead River country we surprise a little bird fluttering in and out of her nest, and she lays an egg between two of our peeps into it, is able to tell us authoritatively that she is the hermit thrush. The butterfly hunter and the photographer are apt, also, to be along on our excursions. When the Josselyns move

in procession across some farmer's pasture to reach the bank of the stream where the cows go down to drink, the spider bottle and the butterfly net, the bird-glasses and the camera march with the vasculum and portfolio of the plant collector and the knapsack of the student of cryptograms.

The reaction of the native of the land to these processions is varied, some being curious to know what pay we get for it. Generally, however, we find someone who understands, and who can guide us to the choice hidden places where nature's treasures abide, as Mr. George R. Howe in Norway piloted us along the trail through the mossy woods to where the Showy Lady's Slipper was blossoming in abundant beauty; or Miss Andrews and Miss Corning in Oxford led us to the sand plains where the Wild Lupine has its only known station in Maine; or Miss Grace Hunter accompanied us to the beaches and bluffs of the coast near Machias; or Mrs. W. E. Hanson conducted a party to the sphagnous swamp in Alfred and Lyman where a quantity of White Cedar was growing, which had not been previously established as to be found in Maine; or Miss Harriet Abbott led a party in Fryeburg straight to the haunt of the Mountain Laurel. Often in this way valuable new members are gained for the Society.

How many red letter days the Josselyn society has to remember! What Josselyn will ever forget that beautiful day on the sides and summit of Mt. Agamenticus, or the one spent on Great Cranberry Island off the ocean side of Mt. Desert; or the next day, part of it, in the pouring rain on Jordan Mountain; or days spent on Rowe Pond, Thompson Pond, Lake Messalonskee, or Moosehead Lake; or the days when we followed the banks of the St. John up and down stream from Ft. Kent?

The botanical results of the Society's excursions have been considerable. Nearly every meeting either adds new species to the list of the State's plants, or at least finds new stations for known species of limited range, while a few species new to New England or to the country or even to science are to the Society's credit. At Wells in 1916 Prof. Fernald presented a list of plants with unverified records in Maine as objects for our search, and several of these "spooks" of the professor's, as they were pleasantly nick-named, materialized during the meeting, one of which was the White Cedar. In 1919 we explored the Carrabasset valley from Kingfield, and made a complete circuit of Mt. Bigelow, passing through the wonderful groves of Norway Pine at Eustis, known as the Cathedral Pines, and a party made the ascent of Mt. Bigelow, while another party was guided along a forest trail to the swamp in Lexington where the Great Rhododendron has its most northerly known station. In Fryeburg in 1920 we hunted the sandy abandoned water courses of the Saco for more of Prof. Fernald's "spooks," and found treas-

ures under the great silver maples that overhang the gravel beaches of the present channel.

The Society has published a bulletin, which has been issued once in a while, six numbers in all, with a somewhat detailed account of its meetings and lists of interesting plants found.

Dr. Dana W. Fellows, president of the Josselyn Society, to whose unwearied efforts must be ascribed the success of most of its more recent meetings, stated in a circular sent out by him that the Society should appeal to the following classes of people:

1. All members, present and past.
2. All teachers of botany in the schools and colleges of Maine.
3. All nature lovers who wish to know more of the plants about them, and who live to go afield.
4. All botanists in other states who are interested in the Maine flora.

In every thousand of the population there are one or two to whom it represents the height of bliss to wear field clothes all day, to range the deep wet woods, climb rocky hillsides, follow up the stony banks of streams, hunt over abandoned pastures, or explore delectable bogs. This sort of thing is caviar to the general—neither appreciated nor understood. It is to the few who understand, the initiates of nature, that the Josselyn Botanical Society of Maine holds out its hand in invitation, saying, "Come with us, and we will promise you a good time,—every year, four delightful and instructive days in the open, with congenial fellow readers, spelling out the wonderful story-book of Nature."

The secretary of the society is Miss Lena Willis, Naples, Maine, who will be glad to answer inquiries, and will send to anyone desiring it the notice of next summer's meeting.

# THE ORCHIDS OF NORTHERN MAINE.

List of species with descriptions and notes on distribution.

By Olof O. Nylander.*

The soil of the eastern part of Aroostook County has long been noted for its fertility, and the many beautiful flowers that grew originally in our forests amply prove it to be so. The strip of country lying south of the 47th north parallel and west of the 68th meridian, including the towns of Caribou, New Sweden, Woodland, Perham and Westmanland Plantation is exceptionally rich in the varieties of native plants.

The Bangor & Aroostook Railroad station in Caribou is at an elevation of about 407 feet. The Bangor & Aroostook station at New Sweden is at an elevation of 700 feet and the hills in the immediate vicinity rise to above 1000 feet.

When the Aroostook River Valley was first settled, about one hundred years ago, there were many trees and plants growing which are practically exterminated today. Originally our flora and fauna were of the forest types and everything grew under shelter and shade; so when the forest was cut and burned, all the delicate and beautiful colored flowers disappeared and the imported European weeds are taking their places.

The early settlers were largely guided in selecting their lots of land by the forest and flowers that grew upon it. Many of the plants were used for medical purposes; so the pioneers had much more knowledge of the native flowers than the present generation has.

I first came to Caribou in July, 1883, and have made it my special interest to study and collect all the information possible about the geology, paleontology, conchology and botany of Maine, and especially of Aroostook County.

We often read in publications on botany or travel, or in novels and florists' catalogues, of strange and beautiful Orchids from many parts of the world, and the word Orchis has become an expression for something elegant and novel.

It is a strange fact that so few know we have around Caribou about thirty species of Orchids, some very beautiful in colors and strange in appearance; and I hope that by careful search we shall find a few more. Many of the Orchids are rarely seen, and they have never received popular names; so the only way to make these gems of Nature popular is to have good illustrations made of them and the localities where they grow.

* In this article Mr. Nylander follows Dr. Britton's classification and that of Dr. Homer D. House, State Botanist of New York, in his recent work on the "Wild Flowers of New York".

CYPRIPEDIUM REGINÆ WALTER

There are many things to prove that the section referred to above is very favorable for the native Orchids. They obtain large size, are very richly colored, and many of them, like *Cypripedium parviflorum, C. pubescens* and *C. reginae*, have two flowers on the stem, and this is rather rare in other parts of the State.

I have in my possession a specimen of *Calypso bulboso* collected on my farm in Woodland in the spring of 1908, with two flowers on the stem—probably the only double-flowered specimen on record.

I hereby present a list of all the Orchids I have found in the north of Maine, with their common and scientific names, and if limited in distribution the locality is given and other notices, that will aid lovers of these plants to find them.

### Showy Lady's Slipper.
*(Cypripedium reginae Walter.)*

A large and attractive plant that grows in wet, mossy, open cedar swamps. Stems 20 to 30 inches, with five to eight ovate, pointed, hirsute leaves; one, often two, white and crimson colored flowers. They are in their full glory between the 4th and 20th of July.

"It is doubtful if any wild flower surpasses this in beauty,"—(House).

I have collected these beautiful flowers at Siegos River, New Brunswick, and in New Sweden, Woodland, Perham, Caribou, Washburn, Easton, South of Presque Isle, Crystal and Sherman, Aroostook County.

(Note.—A root of this plant sent us by Mr. Nylander in the Fall of 1919, and set out in a wet place in the Knox Arboretum, sent up two flowering stalks in the spring of 1920, and early in July each stalk bore a beautiful white and crimson slipper.)

### Large Yellow Lady's Slipper.
*(Cypripedium pubescens Willdenow.)*

Stem 15 to 25 inches with four or five broad, oval, pointed leaves and one, sometimes two, large, yellow, slipper-shaped flowers; flowers in their prime between June 10th and 20th.

This large and beautiful Orchid used to be common on the hardwood ridges in New Sweden, Woodland and Perham. Patches of a hundred, or more, of these wonderful flowers were often seen 15 to 20 years ago, but the land is now mostly cleared, so they are nearly exterminated.

### Smaller Yellow Lady's Slipper.
*(Cypripedium parviflorum Salisbury)*

The smaller yellow lady's slipper is, in most cases, impossible to separate from the large yellow lady's slipper. It is a common plant, found in swamps and open bogs. The plant is from 6 to 25 inches high, with from three to five oval, pointed leaves and one, often two,

bright yellow, slipper-shaped flowers, blooming through June, July, to the middle of August. I have collected this species in Stockholm, New Sweden, Woodland, Perham, Caribou, Fort Fairfield, Marshall, Castle Hill, Chapman Plantation and Crystal.

Ram's Head Lady's Slipper.
*(Criosanthes arietum R. Brown.)*

A very rare and local plant. I have never seen this Lady's Slipper, but it is liable to be found in some Aroostook bog.

Moccasin Flower; Stemless Lady's Slipper.
*(Fissipes acaulis Aiton)*

This plant has a wide distribution in Maine. It is mostly found in spruce and hemlock forests. A plant with two large leaves near the ground and stem from six to sixteen inches, with one large Moccasin-like flower, white, sometimes pink or rose purple. May 30th to June 20th. I have a plant collected in Westmanland Plantation June 13, 1918, with two large, white flowers on the same stem. This is a very rare occurrence, as the textbooks do not mention it.

I have collected these orchids in New Sweden, Woodland, Westmanland and Perham, Aroostook County; in the forest between Patten and Matagoman Lake, Penobscot County; and Misry Township, Somerset County.

Small Round-Leaved Orchis
*(Orchis rotundifolia Pursh)*

This is one of the rarest plants in the United States. I have found this Orchis in a cedar swamp in Woodland, at Salmon Brook Lake in Perham and at Hanford Siding, Perham.

Stem eight to ten inches, with a single oval or orbicular leaf near the base and a spike of four to sixteen white flowers with purple blue spots. In bloom from June 14th to July 10th.

Showy Orchis.
*(Galeorchis spectabilis Linné)*

I have not seen this plant in Northern Maine, but my friend, F. C. Merritt, has collected it at Dover in Piscataquis County.

(To be Continued.)

FISSIPES ACAULIS AITON

ORCHIS ROTUNDIFOLIA PURSH

## DEPARTMENT OF FORESTRY

Editor { Prof. John M. Briscoe, Orono

### FOREST INFLUENCES.

By John M. Briscoe.

From the earliest times man has felt and recognized the influence of the forest, but in very different ways. The forest was undoubtedly the earliest home of man, its edible products then forming its principal value. The presence of wild animals first developed the hunter, and the chase first furnishing subsistence, later developed into a means of exhilaration and pleasure. It was the mast in the openings in the forest that gave it value for the herder, and only with later development in civilization did the wood product become of chief importance.

To the early Nomadic tribes, the forest was a barrier, a hidden and unknown terror lurked in the shade of deep woods, and the early mythology of China, India, Persia, Greece and Rome all recognize a religious veneration for trees, and a fear and dread of forests as the abode of various Deities. An example of this may be found to the present day in the derivation of our word PANIC. (Pan being a woods satyr having the power to stir up the most dreadful fears and emotions, particularly in any maidens who happened to lose their way in the forest). The earliest restrictions in the cutting of timber, were reservations of sacred trees, making it not only a misdemeanor, but a crime to cut such trees.

As these wandering tribes gradually settled down in a given region, the necessity of clearing land for agriculture became more and more imperative. The forests were a formidable resistance to this development; they became the enemy of man—an impediment in his struggle. Clearings were begun first near the streams and springs of water, and were not carried far into the mountains. These were left for the most part in forest cover, and during the middle ages the relation of forest and mountain was inseparable, until with modern developments in methods of utilization and the ever increasing demand for forest products, even the mountains have been stripped of their forest cover in many regions.

In the early days they were, moreover, an obstruction to trade and intercourse; a barrier between tribes and peoples; a hiding place for enemies; and a refuge for marauders. These conditions were met with even in the early settlement of America, as they have been with colonization elsewhere—the first settlers had to do battle with the forests. They were superabundant, ubiquitous, a menace!

We must remember that at this time there was no development of the natural sciences, and little was understood of the real value or of the growth and history of the development of forests. With the advance in the natural sciences, the true nature of the forest and its relation to man was first understood and appreciated. The many different beneficial aspects came to be studied and valued as the supply of forests was constantly being diminished, and some of these beneficent influences were discovered when, through forest devastation, the disastrous results were only too clearly shown. These forest influences, now well known, may be classified under three groups or divisions, namely: economic influences, biologic influences and æsthetic influences.

*Economic.*

Next to our need for food and water, the need for timber is most pressing. If you do not or have not realized this, eliminate for a moment from our every day life all articles made from wood or from wood products, and you will at once be convinced of the truth of this assertion.

Our wood using industries, in this country alone, pay wages to more than 1,500,000, and represent a permanent investment of some $2,250,000,000; while the products are valued at over $3,000,000,000 annually.

For every 1000 board feet of lumber cut in the woods, $20 is put into circulation, on the average, and of this $\frac{4}{5}$ goes for labor and supplies.

We have some 550,000,000 acres of forest land in this country, and only about $\frac{1}{5}$ of this is publicly owned by the States and the Federal Government. On that owned by the governments, forestry is practiced on over 75%; while it is practiced on less than 1% of that privately owned, or an average of less than 18% for the whole area.

The average growth per acre is estimated at about 12 cubic feet, or some 7 billion cubic feet for the U. S., while the annual cut is known to be 23 billion cubic feet, or more than 40 cubic feet per acre, with an average consumption of 260 cubic feet per capita, as compared with 37 for Germany and 25 for France!

We export one and one-half times as much as we import in this country. The species of the most economic importance, in the order of their importance are as follows: Yellow pine, Douglass fir, White pine, Oak, Hemlock, Spruce, and the states in which this industry is most important are: Washington, Louisiana, Texas, Mississippi, Wisconsin, Arkansas, (Maine 16th). In mature forests growth is balanced by decay, so that there is no advance in value, excepting through a rise in the stumpage price.

More than 100 million acres are burned over annually, and the loss is some 50 lives and over $50 million per annum since 1870 on an

average. Not only is the standing timber destroyed by these fires, but the young reproduction as well, and sometimes the very soil cover that makes the forest possible is destroyed if the fires are severe or repeated. These fires could be prevented at a cost of less than $\frac{1}{5}$ of the amount destroyed annually!

It is said that of every 1000 board feet of standing timber, only 320 board feet are used by the consumer. The rest is lost in wasteful logging, and by fire, insect and fungus damages.

By careful use, and the practice of forestry, we could easily produce more than four times the present growth, or enough to more than supply our present needs.

*Biologic.*

The effects of forests on *precipitation* is of very minor importance. May increase as much as 25%. 100% in forest, 93.9 on edge, and 76.7 outside. We do know, however, that where the greatest forest areas are there is also the greatest precipitation. It is quite likely that the forests are a result of the rainfall, rather than the reverse; but that they have an influence in concentrating rainfall when considered over large areas, there is little doubt. The condensation of moisture on the leaves and branches in the forest amounts to from .4 to .8 inches per annum, and the greater humidity, together with the dampening and cooling of the upper air, has a tendency to increase the amount of precipitation. Large bodies of forest, moreover, check the winds and clouds, forming a mechanical hindrance, and tend to create counter currents which again bring about the same results (effects greatest at high elevations).

Whatever the relation of forests may be to the precipitation, there is no question as to their importance in the disposal of this precipitation. Precipitation is in two forms, rain and snow; and the amount of the two taken together is remarkably constant each year, though the time of distribution by months or seasons may vary considerably. The *disposal of the precipitation* takes place in three distinct ways:

$\frac{1}{2}$ in evaporation—the fly-off (which may be even greater than the precipitation).

$\frac{1}{3}$ flows to the sea—the run-off.

$\frac{1}{6}$ consumed or absorbed—the cut-off.

The effect of forests has been unquestionably proved to be to save from the first two of these losses and to add to the amount absorbed.

The forest forms a sort of matt or sponge in which precipitation is caught and held, first by the leaves and twigs and stems of the trees, and then by the covering of leaves, twigs, moss and humus on the forest floor; and through this it seeps slowly into the soil until the latter becomes thoroughly saturated. In this way the moisture is held and accumulated in underground waters, which go to feed the uniform flow of streams and springs in dry weather.

20% to 50% of precipitation is thus saved for underground seepage.

As the country is built up and deforestation increases, the run-off also increases, for it is no longer held by the forest cover, but flows off along the surface; and in the case of snow it melts much more rapidly and flows off on the frozen surface of the ground and is lost.

For power plants and factories along the lower stretches of the streams, the regularity and uniformity of the supply are quite as important as the volume; and it is for the regulation of stream-flow that forests are of pre-eminent importance; to hold the precipitation, no matter at what time of year or in what form it falls, and to distribute it uniformly throughout the year.

These same streams may also be the source of supply of water for farms, towns and cities along their course, and here forest cover also aids in preventing silting and pollution of the water. Only about 1% of the available supply is used for this purpose; about 2% for irrigation; 5% for navigation, and less than 5% for power; but the forest cover has an important influence on the control of freshet and flood waters, as well as in the prevention of erosion. Floods from unusual conditions, such as cloudbursts, are of course, not prevented by forest cover.

It is the water that soaks into the ground upon which a sustained water supply depends. Run-off water is worse than wasted, for it might have saved some non-restorable resource, such as coal! Recent reports of hydraulic engineers of prominence (Chicago, Minneapolis & St. Paul Railroad) affirm that one horsepower steam costs $150 per annum, while the same energy derived from electricity costs about $40. Steam is wasteful, for fires must be kept up while engines are blowing off steam on a siding, while with electricity, the power may be cut off when not in use. (It is further stated that while a locomotive runs 150 miles and then goes to the round-house for repairs, an electrical engine runs 1200 miles before being returned for repairs.)

Now, forest cover prevents too rapid run-off and so conserves the supply of water. The force of the drops of rain is broken, and beating and compacting of the soil is prevented, also the too rapid melting of snow is checked effectively. In our western country, spring floods are often followed in two months by severe droughts; and all over the country the results of deforestation are now plainly felt, particularly in our largest drainage basins, as the Mississippi and the Ohio. 75% of the water is lost on non-forested water sheds, nor does this represent but a part of the waste, for the damage done by these floods must also be considered. These floods are new in this country. Many can not understand them, since we have not any greater precipitation than formerly; but they are no novelty in Asia and in Europe; and millions have already been spent there to prevent their occurrence.

The *control of torrents* and torrential summer rains is another important function of the forest cover. After such rains you will see a muddy stream more or less swollen. The muddy color is due to the wash from the fertile farm lands through which the river has come. It represents the best and most soluble part of the soil, and its loss is in every instance a detriment to the farm from which it has come.

The water in the mountain stream is never muddy, though it may be over a very steep slope. In the forest the bed of leaves arrests the flow of water, covers and protects the soil and holds it in place.

The torrent and land-slide areas in France and Switzerland have cost those countries many years of painstaking toil and much money to restore the forest cover when it had been carelessly removed; and we are experiencing much the same results in some parts of the west today.

This brings us to another important forest influence, namely: the *Prevention of erosion.*

Every particle of matter on our hillsides is on its way to the ocean level, so long as the law of gravitation exists. The more soluble the substance, the more rapid its descent to the water level—lost to our productive acres. This means not only a loss to agriculture, but a loss to water consumers and to navigation as well, for all this material is carried into the rivers from the small streams and brooks by which they are fed. The disastrous results are hastened greatly by exposure to the action of wind and rain. The effects are not limited to China or Asia Minor, but may be plainly seen in many parts of this country today. In fact, the evil effects of soil erosion over denuded areas are everywhere evident. Not only is the best and most fertile soil being carried away from the farms and woodlands on the hills, but the loss to the groundwaters in this surface run-off is tremendous. Moreover, the silt and debris fills up the streams and rivers, and they will have to be dredged at great expense, and they will be fouled and polluted and made unfit for drinking purposes.

There are too many such instances. The problem is a large one—too large to ignore. Older and more experienced nations have learned not only that such evils must be corrected, but have corrected them, though at a cost of millions where thousands would have sufficed if restorative measures had been applied earlier.

Fertile soil is perhaps the most precious inheritance we have received from the long past. It forms but a small part of the earth upon which we tread. Once removed, or destroyed, it is with great difficulty restored. Without it no crop can be raised. In the eternal round of things it is constantly moving to the ocean level, and is constantly being formed again. The rate of its removal and the rate of its formation are factors which determine whether

the capacity for production of food is increasing or diminishing. On the farms the one problem is how to maintain the fertility of the soil; in the forest the soil of itself renews its fertility.

Under all conditions there is a certain wear of the earth's surface. It is greatest on steep, treeless slopes, unless they are so rocky as to resist erosion. There are thousands of acres of such steep hillsides on which nothing but rocks appear, the soil having been washed away. But trees or no trees, the wear goes on, though infinitely slower with than without trees.

When the forests are cut and removed, the soil follows. It is filtered out, washed away, and with it disappears all prospect of immediate reforestation, except at great expense.

The oldest seats of civilization are abandoned and in desert condition now, where the utter removal of the forest marked the beginning of desolation and the disappearance of man's power over nature, when the soil was removed faster than it was being made!

The greatest function of the forest, possibly, aside from yielding materials useful to man, is *soil improvement.* Forests not only hold the soil in place against the erosive action of wind and water, but what is even more important, the roots penetrate to the deeper layers of the soil, absorb the mineral substances found there and deposit them again on the surface in the form of detritus, which soon becomes humus. The acid secretions of the roots, and their mechanical action even aid in breaking up rocks and so forming new soil as well as making more mineral salts available for plant growth. They help to break up soils that are too stiff and hard, and they aerate and greatly improve the physical condition of the soil in bringing about the valuable "crumb-structure."

Thus the surface soil is being constantly fed, and the mineral ingredients conserved. This deposit, gradually rising to the surface, raises the level and aids in the process of drainage.

Worn out soils, and poor sandy soils may be brought back to virgin fertility by a crop of trees being grown on them for about 30 years.

Trees are one of the very few crops that can be said to actually improve the soil rather than lessen its fertility. Mineral food is returned to the soil by the tree crop, and the physical conditions are greatly improved.

Some forest trees act as *land formers* as well. The mangrove of our southern swamps and bayous grows in mud flats even along the shores of salt-water. Together with the cocoa palm, buttonwood, and sea-grape, it consolidates the muddy shores, catches driftage, and gradually extends the boundary of solid land into the ocean. It also forms a valuable protection to the shores in heavy storms. It is being planted along the line of the Florida East Coast Railway, to protect and build up the land along the route to Key West.

Trees and forests may also have an important influence on the *drainage* of a region.

An oak, standing free in the open with 700,000 leaves will transpire 111,225 kilograms (250,000 lbs.) of water during the five months of the growing season—that is, from June to November. (Even clover can give off twice its own weight in water in a day.)

Cedrela and eucalypts are well known as great "pumpers." In Natal they have been used for draining low, flat lands with great success; and along the Mediterranean melaleuca and eucalypts are well known as "anti-fever" trees. The Roman Campagna was a dismal swamp, fever infected, and almost uninhabitable, when it was planted up with eucalypts by a Monastic order. The results obtained were remarkable, but the credit for them was entirely misinterpreted at the time. The peculiar, pungent, emanations from the foliage, and the nature of the oil found in the leaves were credited with the power of counter-acting the "miasma" or evil influence of the air. The real reason for the change was, as we all know now, the draining of the swamps and thereby putting an end to the breeding of mosquitoes!

In India, where trees of this kind were planted along the irrigation ditches, they had to be cut down on account of their absorbing and diverting too much of the water.

It is true that forests tend to reduce extremes of *temperature*, and the mean annual temperature is from .9 to 1.8 degrees F. less within the forest than outside of its influence. The daily variation may be as much as 5 degrees F.

Even the temperature of the soil within the forest area is less affected by changes in the seasons. In the winter it is 1.8 degrees warmer and in the summer from 5.4 to 9 degrees cooler than without the forest cover. The changes are slower, and never as extreme. The soil never freezes to as great a depth in the woods as in the open, the covering of leaf-mould tends to retain the heat.

The relative humidity is from 4% to 12% higher in the forest in the summer than without. This is due in part to the lessening of wind currents, due to the mechanical interference of the trees, and to the transpiration of the leaves, which has a tendency to lower the temperature and bring it nearer the saturation point.

Every farmer knows the value of a woodlot or strip of trees in protecting the farm from *severe winds* and from excessive and sudden changes of temperature.

As a windbreak for the protection of crops, woods are valuable not only for their effect on sidereal winds but on severe storms as well. Poplars have been planted for many years in great numbers in the middle west, for the protection that they afford grains and other crops from the dry, hot winds that are the terror of the farmer in that region; and in California and southern Florida the citrus

orchards are always protected from wind storms by belts of trees such as eucalypts or some other rapid growing species, to keep the oranges and grape-fruits from being blown off the trees when they are nearing maturity, and so lessening their marketable value.

The influence of a windbreak is felt for one rod for every foot of heighth, and the yield of crops so protected may be increased frequently as much as 50% by this protection.

Protection from *drifting sands* is another valuable influence of forest belts. Probably the best example of this is to be found in the region of Gascony, in France, where some 1,625,000 acres of land has been reclaimed by the planting of maritime pine. This land, after deforestation, became a barren waste, with drifting sand dunes that covered up all vestiges of civilization. This had been allowed to go so far that land in the region was at one time sold for 25 francs for any distance that the human voice would carry! It is today a flourishing summer resort region, and includes the famous city of Arcachon.

On Cape Cod, Mass., extensive experiments have been carried on for many years in holding in check the drifting sands.

As a protection against *drifting snow,* trees are not only much more pleasing and sightly, but also much more economical than the ugly board barriers known as "drift-fences." The railroads are now using and planting trees for this purpose, to hold snow in place where there is danger of drifting or of slides.

All of these biological factors have a direct bearing on the fertility and productiveness of much of the vast *grazing* area in our Western States. The most valuable pasturage is in the mountain pastures, situated in the midst of high forests, where both soil and water are conserved and protection afforded to the hundreds of thousands of sheep and cattle that form so large and so important a part of our national food supply.

*Aesthetic.*

Finally, let us consider the relation of the forest, and its influence on the health, happiness, and ethics of a people.

Congestion of population in and near our large cities leads to want when work is scarce, and to discontent and unrest even when it is abundant. Housing conditions, due to want of room, are bad. There is no family garden from which food may be obtained; no woods to resort to for health-giving recreation and pleasure.

There is room for a vast population in our forest regions, where there is good air, good water, room for a garden, pasture, and poultry. It is often nearer the source of raw material for manufacture, and with power flowing in sight of the home. The removal of many of the factory sites from in or near cities to nearer the power-producing streams is not only possible, but decidedly reasonable and profitable. It would be advantageous both to the manufacturer and

to the workmen, for transportation of the finished product is usually much cheaper than that of the raw material. There is also the decided gain in surroundings for the workmen.

Aside from this, every city should have and maintain a city park or forest, just as it maintains the fire department or the water supply for the community. The value to the community cannot be estimated in dollars and cents. Forests, besides the pleasure they bring to the city bred, are well known as purifiers of the air. They absorb the poisonous $CO_2$ and give off Oxygen. There is no better place to recover or to recuperate from an illness than in the woods. Any doctor will agree to this statement, and many prescribe it regularly to a great number of their patients, particularly in cases of nervous disorders. It is in line with the general movement away from drugs and medicines, and towards giving nature a chance under the most favorable conditions. Thousands can testify, from personal experience, the actual physical benefit derived from a sojourn in the woods.

All sentiment aside, without our forests we would cease to have fresh-water fish with a value for food of over 21 million dollars, and game and fur-bearing animals valued at about the same figure. The value of the forests of Maine, from this standpoint alone—that is, in providing a resort and camping ground for the tourist and sportsman—is known to be something over 11 million dollars annually. In the face of these facts, can we presume to calculate the actual financial value of forests for the whole of the country?

But, besides all these coin-cold figures and statistics, what joy would be lost to the fisherman and hunter if this, his chief source of pleasure and enjoyment, were to be cut off! And even for those who do not fish or hunt, the æsthetic pleasure derived from merely living in the forest cannot be duplicated or even paralleled. Every sight, sound, and odor bring their message to pleasurable sensations which cannot be found in any other surroundings. It is the home and refuge for birds and wild life in general, and here we must come if we wish to study and to know them. But then there are many other movements on behalf of conservation with which those promoting the conservation of our forests and the conservation of our water powers must necessarily sympathize.

Last, but by no means least, consider the value of the influence of the forest and forest surroundings on the character and moral fiber of the people.

Men born and bred in the mountains—the forest regions from antiquity—have always been healthy, brave and self-confident. From the earliest times, it was the mountaineer who usually conquered, largely because he was trained and accustomed to conquering—conquering nature, in the world-old and every-day battle with the ele-

ments. From the days of Thermopylæ (480 B. C.) to modern Switzerland, the forest-bred, mountain people have no need to be ashamed of their record in history!

At the time of our Civil War the Southern Confederacy was "practically cut in two by the wedge of loyal mountaineers from the Appalachian chain. They startled the nation by sending 180,000 of their riflemen into the Union Army." And they were in no wise different in loyalty and in efficiency from other mountain-bred people from Maine to Georgia.

We cannot obliterate the fact that mountain men, unassisted, saved North and South Carolina and Georgia during the Revolutionary War and paved the way for the final surrender at Yorktown by their victory at King's Mountain. Neither may we forget that it was the woodsmen of Tennessee that saved the day for Jackson at New Orleans, in the War of 1812. It was the mountaineers of New Hampshire that prevented the escape of Burgoyne at Saratoga. It was in response to Ethan Allen's emphatic demand that Ticonderoga surrendered to the "Green Mountain" boys. Nor can we forget that the famous "Buck-tails," the first Rifle Regiment of Pennsylvania, came for the most part from the lumber camps of the State.* These are only a few instances in support of this assertion, but they will suffice.

Until the millenium dawns and men cease to learn war, the influence of the forest, in the development of such stalwart character and moral fiber, will continue to be one of the most important assets of our national life.

Dr. Charles W. Eliot, at a meeting of the American Forestry Association held in Boston, Mass., Jan., 1916, said in part:—

"I find the moral significance of these conservation efforts to be deep and broad. Their chief significance for one whose life has been devoted to public education is their moral significance, and I find that the various movements for the conservation of the public health of our people are all in line with this movement for the conservation of our forests, for the perpetuation of features of natural beauty, for giving access to the forest parts of our country for the purpose of outdoor enjoyments."

"This movement on behalf of the American forests is part of a widespread and deep-stirring movement for conservation in general of all those powers which promote the health and happiness of our people."

* (During the Great War, competent critics affirm that the forests of France played a role as important as her artillery. Had it not been for the defensive screen that they afforded during the earlier invasion, the French army, inferior in numbers, could not have repulsed the enemy at the Marne. The forests of Argonne and Ardennes formed a barrier equal to several army corps. And the wooded hills, extending east from Verdun towards the coast, played an important part in the defense of that sector.)

# DEPARTMENT OF GEOLOGY

Editor { Prof. Edw. H. Perkins, Waterville

## HOW THIS DEPARTMENT MAY BE OF SERVICE TO NATURE LOVERS AND STUDENTS OF GEOLOGY.

There are several ways in which a Section of Geology in a semi-popular publication such as the Journal of the Knox Academy of Arts and Sciences, may be of service in the State.

Perhaps the greatest field is in the high schools. The form which geology takes in these schools is usually an elementary course in Physical Geology. Unlike its companion courses in Physics, Chemistry and Biology, Physical Geology is often given as a mere textbook course with little if any laboratory work. This seems all the more strange when one considers the fact that this Physical Geology does not require the expensive laboratory equipment of the other sciences. In a measure this lack may be due to the failure on the part of the teacher to realize the possibilities at hand for out-door field work. There is probably not a high school in the State but is so located that many of the problems discussed in the text may be studied first hand in the field. Although we lack the deeply weathered soils of the southern states, the processes of weathering are well shown in the pebbles of our glacial deposits. Wind work may be studied along the coast or inland in the old marine sands of many of our valleys. All stages of valley development may be found from narrow postglacial gorges to broad, open preglacial valleys. There are proofs of movements of the earth's crust in our drowned coastline and our marine clays. Glacial features are everywhere well developed. Striated bed rock, till, modified drift, morainic and aqueo-glacial deposits of nearly every possible type, and disorganized drainage may be found within comparatively small limits. These same deposits when cemented by calcite or iron oxide give excellent examples of sedimentary rocks in the making. These features of our Maine Geology are only a few of the possibilities offered for out-door laboratory work. This department of the BULLETIN, by publishing articles on the local physiography, will serve to acquaint teachers with the possibilities of the various sections of the State for field work.

A second service which this department will give to the scientific students of the State is to act as a clearing house for Geological information. A student may have some problem in his locality which may be of interest to others in the State. The BULLETIN gives such a person a medium of communication with others of the

same interests and at the same time acquaints him with what they are doing in their fields. The articles which the BULLETIN prefers are those which will be of interest to a serious student of Geology and at the same time are so written that an educated layman without specialized training in geology may read them with profit.

The geological section of the BULLETIN may be of service to the person who has no especial interest in geology, but who has an interest in outdoor life and natural scenery. A lover of our hills and valleys, our lakes and streams, would have his enjoyment in them increased if he could read the story they tell of their past history. The level top of a hill blue against the setting sun may tell the story of an old plain once at sea-level now lifted by some mountain building movement of the past. A lake mirroring the forest in its cool depths is there because a glacier halted its northward retreat long enough to build a morainic dam across the valley. Wherever one turns, the landscape bears traces of its past history. The interpretation of scenery in terms of geology is a field in which very little has been done, and the interpretation of the scenery of our State in terms of its past history is one way in which the BULLETIN can be of aid to the lover of nature.

Maine, like the rest of the New England states, has many unsolved geological problems. In the solution of these problems, the Geologists of Maine may contribute to the advancement of this science. Very little is known concerning the history of the various formations making up the bed rock underlying the surface gravels. Some sections near the coast have been mapped in detail. Over most of the State the age and relations of the rocks are known only in the broadest sense. The fossils, which are the geologists' time markers, have, over large areas, been destroyed by metamorphism. One way in which members of the Academy may contribute to our knowledge of the geology of the State is by reporting new fossil localities. In addition to the lack of fossils, the geologist interested in the structure of the bed rock is hampered by the fact that the glacial gravels cover most of the State and effectively hide the bed rock. The gravels themselves furnish many problems. In what manner were they formed? Were they formed by the glacier itself, by floods of ice-water, or by the waves of the sea during a submergence of the land? We have gravels of all three types in Maine.

There is also the problem of the number of ice sheets concerned in the formation of our gravels. In the interior of the continent six invasions of the glacier are recognized. Some geologists find traces of four on Long Island. So far we have evidence of but one ice sheet in Maine. Was this the only one, or was it the last of several, removing all traces of its predecessors in its advance? Some day we may find remains of old gravels that will tell the story of glaciers older than the one forming the bulk of our deposits.

Our hills and mountains have their problems, also. For some time it has been believed that the hills of New England are remains of an old plain now elevated and carved into hills and valleys. Recently evidence has been brought forward indicating that this plain in southern New England is really a series of terraces carved by the sea as it stood at different levels over what is now land. What was the history here in Maine? The above are only a few of the many problems which yet await solution in our State. To their solution each member of the Academy is invited to contribute his bit of observation or theory.

To accomplish its aims the Academy and its Bulletin must have the support of the scientific students and teachers of the State. This support should be given not only by subscriptions, but by contributions to the BULLETIN as well. If you have any article of geological interest, the BULLETIN will be glad to receive it. If you have no article of your own, but have a subject which you would like to have considered, the editor would be very glad to know of it. If the members of the Academy will support the BULLETIN in these ways we will be able to consider the subjects which will be of greatest interest to the greatest number of geological students.

EDWARD H. PERKINS.

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A three days' field meeting of the Knox Academy of Arts and Sciences will be held this season at the Knox Arboretum, Thomaston, on August 24, 25 and 26. There will be excursions to the lime quarries, islands off the Knox County coast, and other points of natural interest. In the evening papers will be read, or lectures given, on Natural History topics, in the Knox Museum lecture room.

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## DEPARTMENT OF NATURE STUDY

Editor } Prof. William L. Powers, Machias

### BEES AND BIRDS AS BUILDERS OF BLOSSOMS.

By John H. Lovell.

So intimately do flowers enter into every phase of life, and so eloquently do they express every emotion, that it was long believed that their bright colors, sweet odors and varied forms were created solely for the benefit of man. "There was no particular reason why the earth at the time of Adam should have literally been strewn with blossoms," once wrote a well-known author, "there was only one man to see them." It occurred to no one that their beautiful hues might be useful to the plants them selves. But the wild flowers would have been not one whit different today, had the appearance of mankind been deferred to some far distant future.

For the development of conspicuous flowers with brilliant colors we are indebted to insects. Bees, especially, have been the humble, unconscious agents in producing results which have profoundly affected the welfare of modern civilization. As regards appearance, flowers may be divided into two great groups. The grasses and sedges; many hardwood trees and shrubs, as the alders, birches, poplars, elms, oaks and beeches; and many homely weeds, as the pigweeds, sorrels, ragweeds, docks and pondweeds, produce only small green or dull-colored flowers pollinated by the wind. Most people never know that these plants bloom at all. But the pinks, buttercups, clovers, gentians, roses, orchids and lilies are known of all men. They are pollinated by insects; and the allurements they offer to attract their visits are happily an endless source of pleasure to mankind.

The primitive flowers were all wind-pollinated. They were small, regular in form, without bright colors and for the most part odorless. Insects searching for food were at first attracted by the abundant store of pollen, a substance which is rich in proteids. Bees, flies and beetles today often gather pollen from wind-pollinated flowers, as the poplars, elms, hickories and ragweeds. The next step was the production of nectar. As nectar is secreted by the leaves of many plants, and the organs of the flower are only modified leaves, it would be very likely to occur in a few flowers. Insects were at once attracted in much larger numbers, and flowers secreting nectar possessed a great advantage over those which were devoid of it. For the same reason bright colors and alluring odors were in time developed.

Gradually the forms of both flowers and insects were modified. The need of protecting the nectar from rain led to the development of tubular nectaries, and this in turn to the lengthening of the tongues of many insects. The bees, of which there are some 4,000 species in North America, are dependent on pollen for brood-rearing and are thus compelled to constantly visit a great number of flowers. It was a momentous epoch in the history of the plant world when the ancestors of the bees became flower-visitors. More than any other group of insects they have played an important part in the evolution of conspicuous flowers. As a result of their numbers, frequent visits and mental acuteness, many flowers are dependent on them for pollination, and are known as bee-flowers.

Bee-flowers occur in a great number of plant families. The pulse family, for instance, to which belong the clovers, alfalfas, peas, beans, vetches, locusts and lupines, contain several thousand. They are also common in the mint and figwort families. Among bees the bumblebees have the longest tongues and many flowers are adapted to them alone, as the larkspurs, columbines, monkshoods, snapdragons, red clover and turtlehead. Bee-flowers are usually red or blue. In the German and Swiss flora there are 482 bee-flowers, of which 330 are red and blue and 152 white and yellow.

A small number of flowers are pollinated by butterflies and are called butterfly-flowers, as the pinks, some primroses, lilies, heaths, orchids and species of phlox. The floral tube of butterfly-flowers is usually so long that the nectar cannot be reached by bees, and the corolla is commonly red-colored. Blue butterflies, however, seem to favor the blue flowers of Phyteuna.

Another group of flowers open only in the evening and are pollinated by hawk-moths, as the thorn apples, various cacti, the evening primrose, the night-flowering catchfly, bouncing bet, the evening lychnis, and various species of tobacco, gentians and lilies. Hawk-moth-flowers are almost invariably white or yellow, and have very long nectaries or floral tubes.

Fly-flowers are widely different from any of the groups described. They comprise pit-fall flowers, prison flowers, pinch-trap flowers and flowers with deceptive colors, odors and nectaries. Familiar fly-flowers are the carrion flower, the arums, Jack-in-the-pulpit, Dutchman's Pipe and the milkweeds. The insects are held prisoners for a time, and then are permitted to fly away, carrying more or less pollen on their bodies, to another flower.

Only a few bird-flowers are found in North America, but they are very common in tropical South America. In the two Americas they are pollinated by humming-birds. In eastern North America only one species occurs, the ruby-throated humming-bird, but in South America more than 400 kinds have been described, and they

fly throughout the year. Common bird-flowers are the cardinal-flower, the trumpet honeysuckle and the painted cup. Bird-flowers are usually scarlet or crimson.

Flowers cease to be merely bright bits of color in the landscape when we know their life histories, their rivalries, and—yes, their comedies. The study of a plant is only begun when we have learned its name. Seek to know the purpose of its form, structure, and why it blooms at a certain time. The marvelous adaptations of flowers occasionally surpass the bounds of the wildest imagination. The opening and fading of the flower, the movements of its organs and the behavior of the insect guests, which may range from 1 to 300, afford an endless field for observation.

"Think of all these treasures,
Matchless works and pleasures,
Everyone a marvel, more than thought can say."

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We want every scientist, naturalist, nature lover, student and teacher in Maine, young and old, to become a member of our Knox Academy family and to make free use of the JOURNAL in recording their observations, their "finds," telling about their trips to the woods, fields, lakes and seaside. Tell the rest of us something of the habits, songs or actions of the birds, mammals, insects, flowers, etc., seen on these trips. Work out the life history of some insect—there are thousands of insects whose life histories are unknown, or only partly known—note the kinds of insects visiting the different kinds of flowers. There is much still to be learned of the habits of birds and animals (all kinds of animals, from the amœba to man). Send in photographs. We shall award prizes to young nature students making the best ones.

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# The Maine Naturalist

## Journal of the Knox Academy of Arts and Sciences on the Fauna, Flora and Geology of Maine

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THE

# Maine Naturalist, Journal of the Knox Academy of Arts and Sciences

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If thou art worn and hard beset
With sorrows, that thou wouldst forget,
If thou wouldst read a lesson, that will keep
Thy heart from fainting, and thy soul from sleep,
Go to the woods and hills! No tears
Dim the sweet look that nature wears.

—Longfellow

AUDUBON JUNIOR BOYS

THE LOG CABIN

## DEPARTMENT OF ORNITHOLOGY

Editors { Arthur H. Norton, Portland
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# THE AUDUBON SOCIETIES OF BRUNSWICK

By Alfred O. Gross

In order to stimulate the organization of bird clubs among the boys and girls of other towns of Maine, it seems fitting to present a brief account of the work being done by the 'Robin' and 'Bluebird' Junior Audubon Societies of Brunswick. These two societies are composed of boys and girls of twelve or more years of age and who have an active interest and keen enthusiasm for bird and nature study. Since the organization of these clubs, so much has been accomplished in the study of nature and especially in arousing public sentiment in favor of our wild birds that they have come to be recognized as a source of great good to the community. Many of the boys who formerly thought of a bird merely as a mark for their slingshots and air rifles, are now directing their energies in ceaseless effort to protect the birds which they have learned to be valuable and useful creatures. If the boys and girls of this generation are taught the great lessons of nature, it will be an important factor in making them better men and women, as well as more useful citizens.

The two societies hold their meetings in the Searles Biological Laboratory of Bowdoin College. The educational leaflets published by the National Association of Audubon Societies are used as the basis of study of the birds, but the members also have the privilege of studying the mounted specimens and extensive collection of scientific skins of the college, which aid materially in presenting to the boys and girls a correct impression of the size and markings of the various birds. The economic value of the birds is continually emphasized and an effort is made to present, in a popular way, the interesting scientific features relating to migration, behavior and instincts of these most fascinating of all wild creatures. After this intensive laboratory study, they are well equipped for their task of identification and study of birds as they are found in nature, and indeed, these boys and girls greet a bird which they see in the field for the first time, with the same delight as they would an intimate companion.

To encourage observation and interest in keeping records, the best original articles written on nature subjects are published in an attractive bulletin issued each year. The bulletin for 1920 contained in addition to the lists of the officers, active and honorary members and reports of the officers, the following original articles: "A List of 88 Birds Seen and Identified on the Field Trips Taken by the Audubon Societies"; "A Typical Field Trip"; "My Birdhouse Tenants During the Summer of 1920"; "My Bluebirds" and "The Life History of the Rice-bush Silk Moth." The bulletin for 1921 promises to equal, if not surpass, the excellent efforts made by the boys and girls last year.

Sometime during the month of October, an annual exhibit is arranged in the Biology Museum of the Science Building, which gives the parents of the boys and girls and the friends of the societies an opportunity to see the nature of the work the young people are doing. At the exhibit last Fall, there were five general groups of entries as follows: Bird houses; Color work; Insect collections; Used nests; and Photography, all of which represented the original work of the members. Prizes were given for the best work in each division of the exhibit. The bird houses were made in many varied designs, some of which required great skill for their construction. A large number of the houses were occupied by birds during the summer, a coveted recognition which added tremendously to the interest in bird house building. The construction of the bird houses, as well as the color work, is done in co-operation with the Art and Manual Training Departments of the Brunswick High School. The color work is chiefly of birds which are studied at the weekly meetings. At these meetings each member is provided with an Audubon educational leaflet which contains 4 pages of text, a colored plate and an outline drawing of the birds and objects of the colored plate. The latter is painted in water color or crayon, as the boy or girl prefers. Such work not only increases skill in coloring but it also teaches the marks and colors of the bird in a way that pages of description could not possibly do.

In the collecting of used-nests, the members are cautioned not to disturb nests which are in the process of building or which contain eggs or young. As soon as the young have flown, the nest is carefully removed and, with a card containing all the data obtained concerning the nest and life history of the birds, is preserved in the museum. The nests exhibited represent a varied type of bird architecture, from the mud nests of the swallows and the simple ground nest of

the sandpiper, to the beautifully built hanging nest of the Baltimore Oriole. Over one hundred nests representing thirty-five species were shown at the last exhibit. This collection, needless to say, is becoming most valuable for a comparative study of bird nests. The work in photography is limited to those boys who own a camera. Some of the work of the older boys is excellent and would be a credit to a professional nature photographer. There are always many entries in the insect collections because of the abundance and ease with which the material may be collected. The boy and girl has an opportunity to develop great powers of observation in studying insects, and it certainly requires skill to mount and prepare them properly.

Last Spring the two societies observed the week of April 8th, 'Bird Week,' with appropriate exercises. One of the events was a spirited public bird identification contest held at the Science building, between the 'Robin' and 'Bluebird' societies. A group of 60 mounted birds and skins were chosen to test the ability of the contestants to readily recognize our common and more important species. That this contest created an impetus to bird study is evidenced by the constant use made of the bird books of the public library and of the ornithological collections of the college museum prior to the contest. This contest created such desirable competition between the two societies and proved such a delight to the audience that it will probably become an annual Spring event at Brunswick. All during 'Bird Week' the boys sold bird boxes to people who wished to attract birds to their homes and gardens. Fifty fine bird houses which were made by the boys at the Manual Training shop of the High School were sold, and twice that number could have been disposed of had the boys made as many boxes. "Bird Week" ended with 'Tag Day,' a day when every member was on the streets with large printed red tags, which were pinned on any one who was willing to make a small gift to the society. The members hoped to raise $50.00, but when the day was ended, they had a sum exceeding $200.00, a splendid recognition and stamp of approval by the people of Brunswick for the work of the Audubon Societies.

Bowdoin College has granted, to the Societies, the use of a part of its two hundred acre wood lot, for the establishment of a 'Bird Sanctuary.' A log cabin has been erected on this reservation which is one and one-half miles from Brunswick, in a place isolated among the pines yet very accessible to the members. Near the cabin is a large bog with numerous springs and a running brook. Nearby is an extensive

growth of shrubbery and hard wood trees making a good combination to attract an abundance of bird life. The cabin serves as headquarters for the boys when they are at work erecting bird houses and feeding stations and for all field trips to the sanctuary. Each summer the Life history of some bird is studied intensively, and this cabin is one of the greatest assets in carrying on work with such birds as the Hermit thrush, which nest in abundance on the ground among the pines of the region.

An army pyramid tent, 16 feet by 16 feet, has recently been purchased for use when large numbers are camping at the reservation or at any of the numerous attractive camping places in the vicinity of Brunswick. In September this year the boys' society will camp for ten days at Cundy's Harbor, where there is an excellent opportunity to study water birds, as well as the land forms of bird life and to see something of the Fall migration as it takes place along the Maine coast.

It is hoped that active Junior bird clubs will be formed in other towns of Maine, for we believe a flourishing Audubon Society is sure to be a source of great pleasure to the young people, as well as a valuable asset to the community.

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Major Barrington Moore of New York City, editor of "Ecology," and who has recently become a contributing member of the Knox Academy of Arts and Sciences, in a letter to the managing editor of this Journal writes: "I have been very much interested in going over the literature which you sent, and was impressed by the vigor and thoroughness of your organization. The bringing together of the scientific interests of this State is a splendid movement which deserves the hearty support of everyone. You have in this State unusual opportunities for scientific work, and your organization can be of great assistance in furthering such work. For example, in forestry the opportunity is particularly promising not only because of your vast areas of forest land, but because you have as State Commissioner a man of unusual ability, who was intimately connected with research work of the U. S. Forest Service for a number of years."

## BIRDS OF LEWISTON-AUBURN, MAINE

Lewiston and Auburn are twin cities of the Androscoggin valley. Lewiston was the home of Prof. J. Y. Stanton of Bates College to whom the majority of bird lovers of this vicinity trace their first interest in birds.

The Stanton Bird Club belongs to these cities. Probably no locality has more bird life than this. The Androscoggin river gives us more water birds during the migratory season. Lake Auburn, three miles away adds to our list through one of our members who lives near. No Name Pond in Lewiston no doubt has much of interest, but none of our members live in this vicinity so I am not familiar with its birds.

Most of our bird students live within or just outside the city limits, so I will write more fully of the birds we see within a radius of two miles from the heart of the city.

Riverside Cemetery on the bank of the Androscoggin river, David's Mountain, the college woods and vicinity, along the railroad track to the Fair Grounds, Eastern Avenue in Lewiston, the "Logan," Dennison Street gully and Franklin land in Auburn are the mecca of the Stanton Bird Club. Here we hike spring mornings starting at 6.30.

Auburn Heights and Prospect Hill, (Auburn) neighborhoods are good bird territory but not near enough for our morning walks.

Our first spring migrant is the prairie horned lark which arrives about the 22nd of February. Next comes the sparrow hawk. About the middle of March or a little later bluebirds, robins and song sparrows are seen and heard, for these birds come in full song.

March 7 was the earliest date recorded for a bluebird until this year when one was seen on Frye Street, February 7, and he was singing. It is difficult to say which is the earlier arrival the bluebird or robin. To the city dweller the robin comes first, and that spring morning when his note is heard we can say with Edmund Clarence Stedman:

> "The sweetest sound our whole year round,
> 'Tis the first robin of the spring!
> The song of the full orchard choir
> Is not so fine a thing."

Outside the city limits the bluebird is the earliest to greet us with his spring song. The song-sparrow may arrive the same morning as the robin and bluebird. The cheerily of the robin, the trual-ly of the bluebird and the sweet-sweet-sweet-very merry cheer of the song sparrow are welcome sounds especially if the winter has been severe.

The redwing and rusty blackbirds, bronzed grackles meadowlark and junco are among the earliest arrivals.

After the thrill of these first bird songs is over there is no more delight to every music lover than the beautiful notes of the fox sparrow. Some years, as this, he goes to his northern home by another route, so very few are seen and I feel something has been lost out of the spring migration.

Herring gulls are flying over the river as early as this and crows have been cawing for some time. Some of our members who live farther away from the city will report hawks, ducks, geese and woodcock the last of March and first of April. The hawks seen are the American roughlegged (rare), American sparrow, broadwinged, cooper's, duck (very rare), marsh, pigeon, redshouldered, red tailed, and sharp-shinned. Some years the Club on its walks near the city has seen the Am. sparrow, cooper's, marsh, redshouldered, and sharp-shinned hawks; the Canada goose, sheldrake and black duck. When the Club takes its first walk we list about ten different species including the English sparrow, which we never count again.

The last blackbird, the cowbird, arrives early in April (it has been seen the last of March)and also our first flycatcher, phoebe. Some morning the rattle of the belted kingfisher will catch our attention when our walk is by the river and we will see his blue and white plumage as he flies over the water.

Some seasons purple finches greet us the last of March or first of April with their beautiful notes. This year they were quite plentiful. A flock of cedar waxwings has been around and goldfinches in winter plumage are no uncommon sight.

A brown creeper and white throated sparrow may be reported. The birds that came earliest are becoming more numerous, so by mid April there will be some excitement on a morning walk, for more migrants are due at this time. The first warbler, the yellow palm, comes with his constantly wagging tail, the golden crowned kinglet and the ruby crowned of which Aububon wrote that its notes were canary like and on holding one in his hand said "so this is the tiny body of the songster from which came the loud notes I heard." Arthur G. Staples has recently called him "a little spark of God's eternal promise weaving a melody to

nothing at all except the Maker and the genius of melody." Savanna, swamp, vesper, field, chipping and white throated sparrows come. April has been called the robins month, but it is also the month of the sparrow, for if the white crowned is seen, as it is some years in April, the whole family is here during this month. We also see the flicker, yellow bellied sapsucker, purple finches, tree and barn swallows and the winter wren. This species is rare in migration. One of our members who lives outside the city often reports bank swallows in April. At one martin house the purple martins often come Patriots Day.

About the 19th of April we see, and hear the beautiful notes of the hermit thrush, the bird that Mabel S. Merrill says "makes the woods ring with the marvelous music that seems to express all the longings and raptures of a voiceless world and whose celestial strains come floating to us out of the shadows, as if all the wistful beauty of the budding world had been distilled to pure music."

The blue heron arrives at Lake Auburn. Later in April we see the osprey stopping around the "logan" or a little farther up river a few days to fish before going to Lake Auburn for the summer. More warblers, the pine, black and white, and myrtle arrive, for the insect world is waking up. We may see the loon as he flies overhead from one lake to another. The brown thrasher, whose notes are a whole orchestra, and the loggerhead shrike (the A. O. U. cheek list calls our northern species the migrant shrike) are April arrivals. The bald eagle is reported at Lake Auburn.

During May, the best month of all the year for observation of migrating birds we find the first vireo, the blue-headed or solitary, followed a few days later by the yellow-throated and warbling. The redeyed does not come to us until the latter part of the month. The bank swallow and the last of the family, the eave, are at their nesting places. The northern water thrush, green heron, chimney swift, American bittern, chebec, spotted, and some years the solitary, least or semipalmated sandpipers are listed. Occasionally a chewink stops on his way for us to get a good study. This bird nests at North Auburn.

When the warblers begin migrating the mornings are busy ones. It requires alertness to catch a view of their small bodies, but their bright plumage is a help. Their bodies are more attractive than their songs. The black throated green, black throated blue, Nashville, yellow, chestnut-sided, parula and magnolia warblers come first. We also get the rose-breasted grosbeak, Maryland yellowthroat, redstart, ovenbird, Wilson's thrush, about which Van Dyke has written

a beautiful poem, "The Veery," oriole, whip-poor-will, kingbird, white crowned sparrow, catbird, goldfinch, in summer plumage, bobolink, house wren and hummingbird.

The olive-sided and crested flycatchers while nesting at North Auburn and No Name pond have not been seen in migration near the city for several years.

The most exciting day of all the spring is warbler day about May 20th. From then on the remaining warblers and other birds arrive. These are the Canadian, baybreasted, blackburnian, Tennessee, Wilson's (black cap), Cape May (still rare) and black poll warblers, the olive-backed thrush, black billed cuckoo (Prof. Stanton told me the yellow billed was here some years), nighthawk, scarlet tanager, the bird that causes the most excitement because of his beautiful red and black plumage, wood pewee, cedar waxwing, indigo bunting, alder flycatcher and now and then a yellow bellied flycatcher.

John Burroughs says June of all the months the ornithologist can least afford to lose. Birds are then in full song and plumage. Birds we find after the middle of June presumably nest with us. These are redwing blackbird, bluebird, bobolink, indigo bunting, bittern, catbird, chebec, chickadee (black cap,) cowbird, crow, black billed cuckoo, purple finch, flicker, goldfinch, bronzed grackle, rose breasted grosbeak, we see the herring gull every day over the river but I do not know of its nesting, ruffed grouse or partridge, American sparrow, marsh, red shouldered and sharp-shinned hawks, green heron, hummingbird, kingbird. I have seen a nest with eggs of the junco on David's Mountain in June, indicating that the first brood was raised here, kingfisher, prairie horned lark, purple martin, meadowlark, nighthawk, oriole, ovenbird, wood pewee, phoebe, redstart, robin, spotted sandpiper, shrike (migrant), chipping, English, field, savanna, song, swamp, vesper, and white throated sparrows, starling, bank, barn, eave, and tree swallows, chimney swift, brown thrasher, hermit and Wilson's thrush, redeyed, warbling and yellowthroated vireos, black and white, black throated green, chestnut-sided, myrtle, Nashville, pine, and yellow warblers, cedar waxwing, whip-poor-will, downy woodpecker, house wren, and Maryland yellowthroat, nuthatches nest at Lake Auburn and woodcock at No Name Pond. They may nest in the locality covered by this paper. I have seen a bald eagle over Riverside Cemetery, but it does not nest here. I have said little about water birds as we have so little chance to observe them. Those I

have mentioned are the more common ones we see on their way to their summer homes.

During the autumn flight there are titlarks (seldom seen in the spring migration.) The Connecticut warbler has been seen a few times.

In the winter months birds are very scarce near the city. We often wonder what the conditions would be if there were no English sparrows. We must take a trolley and then hike to some woodsy district to study winter birds.

Bird lovers on Mountain Avenue, East Avenue in Lewiston, Taylor street and a mile below Prospect Hill in Auburn, have feeding stations. If the winter is extremely cold scarcely any birds will come to those nearest the city. The most faithful is the downy woodpecker. In mild winters like last many different species are visitors.

The birds we may see from November till March are the black capped chickadee, goldfinch, goshawk, evening grosbeak, which feeds on the box elders along our city streets, pine grosbeak, ruffed grouse (partridge,) blue jay, junco, red and white breasted nuthatch, redpoll, northern shrike, snowflake or bunting, pine siskin, tree sparrow, starling, downy and hairy woodpecker. I have seen the Hudsonian chickadee, Arctic three toed woodpecker and a flock of shore larks in the fall and none have been reported in winter though they are considered winter birds. Shore larks are seen outside the city when the prairie horned larks arrive in February. The shore larks go north to nest.

In North Auburn a pileated woodpecker lives through the winter. Golden crowned kinglets are sometimes found in the woods. Crows and herring gulls are here all winter if a mild one. Crossbills have been very rare for several seasons, only one of our members seeing any. Sometimes a song and occasionally a white throated sparrow visits a feeding station. Robins, purple finches, meadowlarks and sheldrakes are here in a mild winter. In 1921 a sparrow hawk was around the city. We never know what bird we may see in winter. One January we saw a brown creeper in Riverside Cemetery. Last winter a barred owl was caught on a building along one of our city streets. A Richardson's owl spent part of a winter on Frye street. There have been other reports of owls in the city. In January 1919 a screech owl flew into a barn on upper Main street.

A few rare birds have visited us. The whistling swan was seen flying over Lake Auburn in November 1917, in October 1920 and April 1921. Bohemian waxwings were seen

in Auburn during the winter of 1919 and again in 1920. An American three toed woodpecker was at North Auburn in January 1919. In the same section was a blue grosbeak a few days in the summer of 1919, also a redheaded woodpecker in May 1917 and 1920.

Mourning doves have been seen a few times in the country in the Spring and Summer, but in the winter of 1920 one came several times near houses in Auburn. A Canada jay was on East Avenue one day in January 1919. The orchard oriole has been reported several times and one spring a lady who had lived where they are common identified one. I have felt that some of the reports were not reliable. The only authentic report of a mocking bird is several years ago when one was about Prof. Stanton's house in the winter. About twenty years ago a Philadelphia vireo was found nesting by one of our members near Farwell's bog. The Stanton Bird Club hopes that the increasing interest in birds will mean that they will come more and more into the city. A robin sang so long in an elm tree in Union Square that we thought he might decide to nest, but he finally left. Every day as I walk down Main Street I hear bird songs as far as Hospital Square and no doubt this is true of all the streets and the Lewiston park which is in the heart of the city.

While the birds return to the same places at approximately the same time each year, as the years go by there are changes. Some birds that nested here twenty years ago are farther away as the crested flycatcher and pileated woodpecker due to the cutting off of woods. When I began my study of birds in 1898 and 1899 there were no meadowlarks or house wrens. Now they are plentiful. Eight years ago bay-breasted warblers and indigo buntings were scarce. Starlings we are sorry to say are coming to this locality. The evening grosbeak, with the exception of the winter of 1889-90 when one was seen, did not come till 1913. Since then they have appeared in flocks nearly every winter. Last season none were reported.

The seasons come and go and when I hear the last bird notes in late summer or autumn I begin to look forward to that "primrose dawn" in March when I can say with Katherine Lee Bates

> Sweet, sweet, O sweet
> And tender, tender,
> The bluebirds shall wake the happy earth
> With song!

CARRIE ELLA MILLER

## BIRD ANATOMY

By Sidney M. Bird

Birds are highly specialized creatures and therefore possess, in their physical construction, many arrangements that are both unique and wonderful examples of fitness and adaptability. Limited space compels us to select only the most common examples that may be briefly described, beginning with the bill.

This instrument is hand and mouth in one. As hand, it takes, holds and carries food or other substances, and in many cases feels; as mouth it tears, cuts and crushes, acting as both lips and teeth, neither of which birds possess. The general shape of the bill may be likened to a cone. This shape gives the greatest strength combined with the greatest delicacy. The end is fine, to pick up the smallest objects, the base stout, to manipulate the largest. Both mandibles, or jaws, are movable, as opposed to all mammals, which move only the lower jaw. Its variations in construction are extreme but always perfectly adapted to each bird's particular needs.

The sparrows and finches with their short, heavy, sharp-edged bills are able, with incredible rapidity, to shell the smallest seeds. All are familiar with the formidable hook-like structure of the hawk and eagle. The sandpipers, woodcocks, etc., have a long and slender bill, soft and pliable, scarcely more than skin stretched loosely over a long bony framework. The sense of touch is highly developed in the bills of these birds, enabling the woodcock, for example, to instantly detect a choice morsel underneath the surface of the mud when it comes in contact with the random thrust of the bird's bill.

The woodpecker has a hard, sharp pointed bill with a spring-like arrangement at its base which may be to prevent the "jar" giving the bird a headache. The ducks have a sieve-liked arrangement similar to and operating in the same way as a miner's sluice, the water washing and separating the mud from the food particles. So we might continue, but the above examples show the specialization and versatility of this organ.

The eye of the bird is a delicate, rather complicated but highly efficient organ. It far exceeds the unaided eye of man in both scope and delicacy, and its ability to focus rapidly and accurately is developed to a marvelous degree. Observe an eagle or a hawk soaring aloft until it seems but

a speck in the sky, with a single meteoric dart it seizes a chicken in the farmyard or a sparrow in the field, an object much smaller than itself and wholly invisible to our eyes from that distance. We can scarcely follow the lightning-like darts of the humming bird, yet he comes to rest as lightly as a feather on a tiny twig. We have no means of knowing at what distance he first perceived it, but however far away, the interval to focus the object could be but a fraction of a second.

The physical construction of the eye differs so little from that of other animals as to scarcely warrant so great a difference in efficiency. A bird may see directly in front as well as at each side. The eye has three eyelids, an upper and lower like the human eye, but the positions are reversed, that is, closing from the bottom instead of from the top, excepting in owls, whippoorwills and other night birds. The third lid, called the "winker," a delicate translucent membrane, starts from the side nearest the bill and operates across the eye at a right angle to the other lids. Menace a bird's eye with the finger and this lid rushes across to protect the eyeball. Owls sit in the daytime with this curtain shading their eyes from the light. When duck-hunting the writer has observed birds swimming under water with this film apparently drawn over their eyes.

Mention of the respiratory system should be made because it resembles that of no other animals except the reptiles, and more remotely the fishes. As we think of a turnip as being nearly all water, so we might say that a bird is nearly all air, being literally permeated with it. We may divide the system into three parts; the lungs, bones and skin, all of which are connected by an intricate network of air tubes similar to the blood vessels.

The lungs, enormously developed, are situated in the thoracic cavity, which is not separated from the abdominal cavity. There is a rudimentary diaphragm, but of little if any use. Inspiration and expiration are performed both by the breast muscles and the abdominal muscles. Instead of the usual single bone, a bird's rib consists of two bones joined by a cartilaginous hinge which allows for this breast movement. Each cavity takes its turn in inhaling and exhaling.

The bones, particularly those of the legs and wings, are hollow and are filled, not with marrow, but with air supplied by tubes from the lungs. One eminent authority says that a bird is able to breathe directly through a hole at the end of the humerus. The writer recollects that when a boy he shot

and wounded a woodpecker and decided that choking was a quick and painless method of killing the bird. After a long effort the bird still appeared to be as much alive as at first, which might indicate that there was some breathing source other than the throat. The third division of the respiratory system is made up of a series of tubes leading from the lungs, spreading out in all directions into a minute network beneath the skin. Authorities agree on the various reasons for this extensive breathing system, notwithstanding that there are exceptions in nearly every instance.

A bird is a quick breathing, hot blooded creature, (temperature 106.9), consumes large quantities of food and is so active as to be almost constantly in motion. These characteristics are consistent with enormous quantities of energy, which also require a corresponding amount of air for combustion.

One is able to hold the arm at a horizontal position for a comparatively short time because the enormous demand for energy to perform the task far exceeds the supply. To enable a bird to maintain itself on out stretched wings for many hours, the wing must be rapidly supplied with energy, hence the arrangement for large quantities of air to these parts, as above mentioned. In short, the available storage space is so inadequate that each wing might be said to maintain its own auxiliary plant to manufacture energy as required. Again, by this complete aeration of the body, its buoyancy is increased. The ability to take a long breath is undoubtedly appreciated by the song bird. Incubation requires a constant quantity of heat, which is readily available beneath the skin surface. The ability to fly is the great distinguishing feature between birds and mammals, the mechanics of which is a marvel of simplicity and perfection. Omitting details we might say that the wing of a bird closely resembles the human arm, although the movement at the wrist is restricted to a plain hinged joint, just as if in the human we were able to bend the hand to one side until the little finger lay against the forearm. It is obvious that if any rotary motion at this point were possible, wobbly and unstable conditions would exist in the wing so as to make it well nigh impossible for the bird to fly.

The muscular control and operation of the wing is most interesting. In flying a bird makes its greatest effort, hence the heavily meated breast. Also as this is the heaviest part of the bird it is placed underneath, acting as keel and balance while flying. Practically the entire wing operations are controlled by these breast muscles, even the upward move-

ments having a pulley arrangement attached to the breast instead of to the back wherein a more direct pull would be exerted but tending to top heaviness.

To control the elbow movement from the breast is obviously simple, but the greater distance to the terminal bones of the wing introduces complications which are overcome by an automatic arrangement, most ingenious. The two bones of the forearm, radius and ulna, have a backward and forward sliding movement. There are two knobs on the upper arm bone at the elbow which fit into a cup on each of the forearm bones. The terminal of the wing or pinion is securely fastened to the other ends of these forearm bones. When the breast muscles straighten the wing at the elbow joint, a knob comes in contact with one of the forearm bones and pushes or slides it forward, causing the pinion bone to automatically straighten. When the wing is folded the other knob pushes on its respective bone causing the pinion to resume its former folded position.

These are but a few of the myriad examples of nature's wonderful devices, by whose adaptability and perfection the eternal fitness of things is made manifest.

## BIRD NOTES AND NEWS

### MIGRATION NOTES FROM WATERVILLE

The first birds to arrive from the south were seen on March 11th when Robins and Bluebirds appeared. The same day a Killdeer was seen flying over a field near the city. Song-sparrows, Juncos, and Purple Finches arrived on the next day, March 12. A second wave appeared March 31st-April 2. In this wave were flocks of Fox Sparrows. Contrary to reports from other parts of the state these sparrows seemed very abundant. They were first seen on March 30th and remained about a week.

From April 19th on birds increased rapidly in numbers. The migration reached its height May 15-18th. Between these dates 21 new arrivals were reported. Some of the more interesting records follow.

The first Startlings to be reported from this section appeared about the middle of March. Two or three pairs nested in Winslow.

A flock of nineteen Cedar Waxwings were seen March

27th. No others were reported until June 3rd, from which date the bird became common.

Tennessee Warblers were unusually common. Between May 17th and 24th several were seen or heard every day. A House Wren was seen in song on May 27th and 28th. This is the first record for the species in several years.

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### A NEW MAINE RECORD FOR BICKNELL'S THRUSH

On July 13th Mr. A. S. Pope and the writer climbed Mt. Bigelow. In the scrub spruce just at the tree line several birds were heard and seen which are believed to have been Bicknell's Thrush. Both Olive-backed and Hermit Thrushes were common low down, giving an excellent opportunity to compare the songs of the three birds.

On August 1st Mr. Pope and the writer again climbed the mountain, this time accompanied by Dr. G. M. Allen of the Boston Society of Natural History. Two nights and parts of three days were spent on the Mountains, but no Bicknell's Thrushes were seen or heard. A few silent olive-backs were seen at lower levels.

As far as the writer knows, the presence of the Bicknell's Thrush as a breeding bird has never been confirmed for any of the Maine Mountains.

EDW. H. PERKINS

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### MOCKING BIRD AT BRUNSWICK

We first heard the bird singing Feb. 8, 1921 and thought it a catbird. The next day saw the white markings and called it a mockingbird although we couldn't believe it was one so far north and in February. However it proved to be and remained with us till April 8 (The last I heard and saw it.) He stayed in and about a brush-pile most of the time going away for ten or fifteen minutes and then back again. He seemed rather fond of being looked at, not at all shy. He sang a great deal, at first not so loud and frequently.

Mr. Runnels put up a feeding board for him. He had been feeding on buckthorn berries driving away robins that came to feed on them, and apples that were left on the trees. We put various foods on the board but of all we put out he liked doughnuts best. Wouldn't touch canned fruits or nuts, that is peanuts or walnuts. We also put out a dish of water from which he drank but we never saw him bathe. When we called him he would often come out of the brush pile

evidently to see what the noise was. He disliked the robins but the song sparrows he seemed to enjoy. Both would be singing on the same brush pile at the same time. Prof. Gross of Bowdoin identified this mockingbird and also some who had seen mockingbirds in the south.

MRS. E. JOSEPHINE RUNNELS

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### BIRD NOTES FOR WARREN, KNOX CO.

The first arrivals the past Spring at my home here near the Knox Arboretum were one song sparrow, three bluebirds and a big flock of crows on March 10. The robins arrived March 12, the Juncos, March 13, a pewee flycatcher, March 24, the flicker April 5, wild geese April 10, hermit-thrush in Arboretum April 14, red-wing blackbird, April 15, tree swallow, April 17, Savannah sparrow, April 20, chipping sparrow, April 26, vesper sparrow, April 26, red-poll warbler in large flocks April 26, Wilson thrush, April 27, nest with three eggs of red-shouldered hawk in red-oak near the Arboretum, April 29, bobolinks, May 15, kingbirds, May 18. Not a single fox sparrow seen here this spring. We missed their sweet song. The Juncos that for past two seasons have nested in the Arboretum failed to do so this spring. The same applies to Cooper's Hawk. Whippoorwill not heard this season. Two seasons ago the red-headed woodpecker remained here on my farm all Summer.

N. W. LERMOND

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The Stanton Bird Club of Lewiston-Auburn has issued a neat little program and schedule of walks for 1921-1922. Regular meetings of the club are held the first Monday of each month at 7.45 P. M. Annual meeting first Monday in October. For further information address the president, Albert L. Kavanaugh, Esq., 219 Oak Street, Lewiston. Maine.

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### THE MOCKING BIRD IN HALLOWELL

Hallowell is one of the few Maine cities that can claim the distinction of having entertained a southern mocking-bird in winter. On the morning of January 2, 1919, this stranger appeared at the home of Mr. and Mrs. Charles Alexander on Pleasant Street, where a feeding station has been maintained for a period of twelve years, and where numberless bird guests have been entertained, summer and

winter. The mocking bird was observed upon its arrival, and from its exclusive perch upon an outward branch of a balm-o-Gilead, it surveyed its fellows and surroundings with apparent interest. It allowed a hairy wood-pecker to finish its meal before going to the suet which it ate very sparingly. Then flew to an orchard, where it was seen to peck ravenously at frozen apples. Immediately a fresh apple cut in halves was tied flat upon a branch of the tree to which it first came, and although it returned in the late afternoon and inspected the situation, it did not indulge. The following morning when the family arose at seven, it was just finishing the last half apple, picking out the soft part and leaving the skin like a cup, with the core in the center. Now that its diet was establish, fresh apples in quantity were furnished, which were devoured after like manner, for it came several times daily, and ate greedily. Its disposition did not seem to improve with acquaintance, for regularly it fought every bird from the tree before meals. It was never seen to visit the tray, where there was always a supply of grain and crumbs, nor did it again take suet; its likes and dislikes were very pronounced, so it stuck fast to its fruit diet, and usually to the one tree, but did go on to the ground a few times, after the snow went.

Its fame soon spread abroad, and open house was kept during the remainder of its stay, for fully fifty persons, most of them skeptical, came from various places to see if it was really true. It became quite accustomed to admiration and would sit in the sun and preen its feathers before an audience of six or eight on a porch not twenty feet away. Several snap-shots were taken, but through inexperience and a very small camera, the pictures were not altogether satisfactory, although in them the bird was clearly visable. Its song was first heard on February 28, and its low musical warble interspered with a loud jay or caw, was an interesting revelation to those who had never heard its notes. With the exception of being absent for a few days on two occasions it remained at the home of its adoption until March 11, when it disappeared only to be discovered in the orchard of a neighbor on March 24, where it remained until about May 1. In late March and April its beautiful notes were heard very often, and a noticeable characteristic was its effusion of song during the warm spring rains. One of its most interesting exhibitions was given on an April morning, when several members of the Ball Bird Club were in pursuit, hoping for a song, and soon after locating it in the orchard, its companion, a song sparrow, rose to a post quite near and poured

out its joyous notes. The mockingbird caught the last strain and repeated the song so exactly that one would not have been able to distinguish the singer, had not the audience caught him in the act. Not only once, but several times was this grand opera enacted, much to the delight of the listeners.

Its visit had been prolonged until every hope was entertained for its permanent residence here, but about May 1 its morning song no longer greeted the nature lover who had visited its haunts daily, for it had gone. On the evening of June 24 it again appeared in the Alexander yard, only to leave a lasting impression of its no less amiable disposition, for it fought a robin from a wild cherry tree, remained about ten minutes, then disappeared, probably forever.

GERTRUDE E. V. ALEXANDER

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## THE STARLING IN KNOX COUNTY

At the field meeting of the members of the Knox Academy of Arts and Sciences Friday, August 26, the ornithologists of the party noted a starling, in company with a flock of sparrows. Prof. A. O. Gross, one of the party, was the first to call attention to the bird. This is the first record, it is believed, of the starling in Rockland, and indicates that the bird is working its way north.

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"Please accept thanks of the Society" (Boston Society of Natural History) "for the first number of the Maine Naturalist. I congratulate you on its excellent appearance and on the personnel of the editing staff. It should result in the preservation and discovery of many interesting facts in regard to our local Natural history."—Glover M. Allen, Secretary.

## DEPARTMENT OF ENTOMOLOGY

Editor } Edith M. Patch, Orono

### A LARGE FIELD FOR STUDY

Entomology, or the science of Insects, offers practically a limitless field for the student of nature.

It has been estimated that over five hundred thousand species of insects inhabit the world, many more than all other species of animals combined.

They are of many sizes, forms and colors; in size from the minute Alaptus fly, less than seven one-thousandth of an inch, that lays its eggs in the eggs of other parasitic insects (the Ichneumon flies,) to the mammoth moth (Actias Isis) from the Celebes that measures seven and a half inches from tip of wing to tip of wing, up and down, and five inches across, or the grasshopper (Trapodous dux,) from British Guiana, that measures 7 1-2 inches from tip to tip of outstretched wings; in form from the insect that resembles little stems of trees or bushes (the walking-stick,) the almost formless bird and book lice and scale insects, the hard-shelled or wing-covered beetles, to the four large winged butterflies and moths and the transparent-winged Hymenoptera; in color from the gorgeous morphos to the pure white cabbage butterfly, and from the bronze and gold "gem" Brazilian beetles to our brown and black ground beetles.

Insects are to be found everywhere, in all kinds of situations: in the fields and woods, in fresh and salt water, flying in the air, under stones, logs and bark of trees, in fruit, grain, and trees, on flowers, leaves, birds, mammals and other insects, in our homes destroying clothing, carpets and food.

No other department of Nature, of the animal or vegetable kingdom, offers such a fascinating, such a boundless field for observation and study. No long, expensive "golden-fleece" journeys are required; the youthful, ambitious explorer into the realms of nature has but to step out-of-doors to find him or herself in the midst of countless golden-winged creatures, creatures of endless forms and colors.

Nor is any costly or elaborate equipment required for their collection and study. A butterfly net that can be made at home out of an old broom-handle, a piece of brass or

copper wire and a yard of mosquito netting; a "killing bottle" containing a lump or two of cyanide potassium covered over with cotton and card board, a few drops of chloroform or a small bottle of benzine, a drop or two of which will kill any insect; a "breeding cage" made out of a wooden packing box, one side covered with wire netting and the top hinged, in which to confine and feed caterpillars; a "spreading board" of two narrow strips of pine board, separated by half an inch more or less, the space between to receive the body of butterfly or moth, cleats nailed across each end to hold strips in place, a sheet of cork glued or tacked over space between strips; a few cigar boxes, lined on bottom with corrugated paper or paste-board, a supply of insect pins and a pair of forceps and "setting" needles and the insect student and collector is fairly well equipped for the field or door-yard and the library or "den" at home.

The field of entomology is so vast that the student will do well to specialize on one order or family of insects. In working up the several orders of the insects of Maine, the Knox Academy needs the help and cooperation of specialists. We, ourselves, will "tackle" the Coleoptera and Mr. John H. Lovell of Waldoboro is at work on the bees. Who will undertake to work up the Noctuid moths, the Tortricids, the Tineids, the Hawk-moths, the Skippers, the Butterflies, the Diptera, the Neuroptera, the Hemiptera, the Hymenoptera and other orders, groups or families of Maine insects?

A work on the Orthoptera of Maine, from an economic standpoint, by Albert P. Morse, was issued last March as bulletin 296 of the Maine Agricultural Experiment Station at Orono, and Miss Edith Patch has done splendid work on the Aphids or Plant-lice, the results of which have appeared from time to time in the Station's publications.

Will all Maine students interested in Entomology kindly communicate with the undersigned. We want all who can to contribute articles for publication in this department of the Academy's Journal.

NORMAN W. LERMOND.

## DEPARTMENT OF MAMMALOGY

Editor { Alton H. Pope,
Waterville, Me.

VIRGINIA DEER

Males showing horns in the "velvet"

Photo taken in summer

Note—This cut should have appeared with Thomas A. James' article in No. 1 of this Journal entitled: "Factors Affecting the Distribution of Game Animals in Maine."

DEPARTMENT OF MARINE BIOLOGY

Editors { Prof. C. H. Batchelder, Orono
Dr. Edwin Gould, M. D., Rockland

## THE STARFISH

By E. W. Gould, M. D.

The following interesting address upon the Starfish was delivered by Dr. E. W. Gould at a recent meeting of Knox Academy of Arts and Sciences:

The starfish is commonly known as "five fingers" presumably for the reason that a starfish consists of a central body from which extend five rays or fingers. This is the general rule but not absolute as specimens are known to exist with seven, nine and 10 rays, the specimen with 10 rays that I had the good fortune to see and examine fresh as it came from the water was some twelve inches, measuring from the distal point of one ray to that of its opposite fellow.

According to the experiments made by Prof. A. D. Meade, starfish possess a prodigious digestive function. He reports that in six days a single starfish devoured more than 50 clams, the clams being about the length of one of the rays of the star, a little more than eight clams each day, or one clam for each three hours. The preparation for the banquet is an arduous, continuous, performance, exertion without cessation. The starfish approaches his victim with a slight movement, a gentle caress, a touch with one of his many tentacles, which is the kiss of death. This is followed by another and another until the shell or valves of the clam or scallop is nearly encircled in the fatal embrace of this master mechanic, whose arms or rays are equipped with many tentacles which are attached to the shell of the doomed mollusk by the power of suction at the exact point on the shell where the least amount of contraction will accomplish the desired result. With an inborn knowledge of anatomy, the position invariably taken in anticipation of the coming feast, the mouth of the starfish is nearly opposite the shell edges just below the hinge at the byssal notch in readiness for their release. With the first gentle pull in opposite directions, made by the enclosing rays, comes a premonition of the struggle in store, and at once occurs a contraction of the adductor muscle of the alarmed mollusk, which action brings valves close shut to prevent the entry of the sinister visitor. But the gentle, insistent pull, with no respite, soon

begins to show results. With this constant strain on the adductor muscle of the bivalve, which is in a state of continuous contraction, fatigue soon becomes apparent until at last in utter exhaustion the valves slowly open, when the first act in this tragedy of the ocean floor is closed. This silent executioner has his intended prey helpless, shell agap, yet the delicious morsel seems beyond his reach. How will he surmount this apparently insuperable barrier? The final act in the tragedy is ushered in by a wonderful phenomenon, now the significance of the position first taken by the starfish becomes apparent, its mouth is opposite the partially opened edges of the shell, and at once there begins a gradual eversion of the star's stomach, which commences to roll out of its mouth, and is pushed by vermicular motion between the edges of the valves, to enter the body of the mollusk in the form of a membrane which spreads over the soft tissues of the victims body. What is normally the inner layer of mucous membrane of the star's stomach, when inverted, becomes the outer layer for the time being, and in close touch with the living banquet. Then from the numerous glands of this mucous layer of the star's stomach is poured out a generous quantity of one of the most powerful digestants known. With man, food in order to be made ready for assimilation must be masticated and thoroughly mixed with tyalin from the sublingual glands in the mouth before entering the stomach. Thus the process of digestion is begun, the tyalin changes the starches of the food into dextrose even before it is swallowed. The food after entering the stomach is acted upon by the gastric juices and acids of the stomach which carry on the process of digestion a step farther, when the partially digested food enters the intestine where other ferments are added to complete the process of digestion.

The common housefly lays its eggs when convenient in dark moist crevices, in meat, or fish, at the same time it deposits in the vicinity of the eggs a strong digestant that soon begins to liquify the flesh, in order that when the larvae are hatched that they may have a semi-liquid predigested food as a medium to wiggle about in and absorb through the delicate skin with which they are covered.

In the case of man the food is cooked to render it more easily digested and is digested only after it has been masticated and taken into the stomach. With the fly the food may be uncooked but not endowed with life and is digested outside the fly's body. This fact would indicate that a much stronger aid to digestion was used in case of the fly than

with man. To the slow moving starfish which has neither the intelligence of man, or the agility of the fly in securing food, is given a digestant of sufficient strength to digest its living food outside its own body.

Where food is alive it is more resistant to the action of digestants, yet the rapidity with which a starfish devours a mollusk is astounding. Frequently within two hours from the time when the starfish begins his pull on the valves of a mollusk, the empty shell is cast aside. This food, which in the beginning was alive, is digested external to the body of the starfish and external to the body of living victim, and is absorbed by the starfish in considerably less than two hours. Located in the rays of the starfish are a large number of glands that secrete this fluid digestant, whence it is conveyed to the stomach. Within the realms of medicine there is no known digestant with any degree of potency compared with that secreted and used by the humble starfish, which if it could be isolated and extracted in sufficient quantity, the possibilities for its use in medicine would be large, in fact would establish a new industry, would greatly lesson the menace to the mollusk fisheries, and at the same time furnish a new means of earning a livlihood to the fishermen.

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If each of our members will secure one application for membership, or a subscription for The Maine Naturalist, this journal will be placed on a self-supporting basis. We want the name and address of every nature teacher, and nature lover in Maine, that we may send them literature in relation to the Knox Academy and its publications.

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Will our members kindly bear in mind that we are trying to get together as complete collections as possible in every branch of Maine Natural history for the use of special students and summer classes, as soon as our museum building is completed, which we hope will be next summer. We are pleased to acknowledge the receipt of a fine lot of herbarium plants from Mr. John C. Parlin of Kennebec County and some very rare dried plants from Mr. Long, collected by him on Matinicus Island—N. W. Lermond, Curator.

## DEPARTMENT OF BOTANY

Editor } Louise H. Coburn, Skowhegan

### THE ORCHIDS OF NORTHERN MAINE

Part II

By Olof O. Nylander

*Coeloglossum bracteatum, Willd.*

Generally distributed in the hardwood forest in New Sweden, Woodland, Caribou and Perham. Plants generally about a foot tall, but under favorable condition will reach 18 to 20 inches in height, with a spike of green flowers five to six inches. In flower from May 20 to August.

TALL LEAFY GREEN ORCHID

*Limnorchis hyperborea, Linne*

Habitat low wet ground and open forest. This orchid is well distributed in Quebec, New Brunswick and Northern Maine. Flowers in May, June and July. Stem with four to six lanceolate leaves. Plant generally about a foot tall, but in the open bogs will attain a height of 30 to 35 inches with a spike of greenish white flowers often eight or nine inches long.

*Limnorchis hyperborea, Linne, var.*

A variety of this plant, with dark green flowers, is rarely seen in the hardwood forest of New Sweden, Woodland and Perham. Flowers in August and September.

WHITE BOG ORCHID

*Limnorchis dilatata, Pursh*

This, the tallest of our orchids, grows in wet and open bogs in Caribou, Woodland, Perham, Westmanland, New Sweden and Stockholm. Stem with four to six long, slender, lanceolate leaves, and a dense spike of small, white sweet-scented flowers. June, July, August and September. I have often seen this plant attain 40 inches in height and a spike of flowers from 10 to 15 inches.

*Gymnadeniopsis clavellata, Michx.*

I have only found this plant around Little Mud Lake, Westmanland. Stem 10 to 15 inches in height with one large obtuse leaf, four to five inches long and one to two

small lanceolate leaves on upper part of stem. Raceme of greenish-white flowers, from three to ten in number. In bloom the first week in August.

*Lysiella obtusata, Pursh*

Scape or stem naked above, one-leaved at base, 5 to 9 inches high. Leaf abovate or spatulate, oblong. Flowers greenish or white, 5 to 15 in a loose spike. Habitat in bogs.

LARGE ROUND-LEAVED ORCHID

*Lysias orbiculata Pursh*

Leaves two, large oval or orbicular, sometimes attaining eight inches in length and seven and one half inches in width, lying on the ground. Stem slender, sometimes 25 to 28 inches in height with a spike of white greenish flowers, rather open and often eight to ten inches long. Habitat in the hardwood forests. July, August and September. Rather rare.

*Lysias macrophylla, Goldie*

This plant is very closely related to orbiculata but is larger. Flowers in June and July and is more generally distributed in mixed and hardwood forests in New Sweden, Woodland and Perham.

HOOKER'S ORCHID

*Lysias Hookeriana, Gray*

Stems stout, with two orbicular leaves lying on the ground. It will sometimes attain a height of 16 inches with a spike of small, greenish flowers, five to seven inches long. May, June and July. A common plant in the spruce and hemlock forests, in Quebec, New Brunswick, and Northern Maine.

WHITE FRINGED ORCHID

*Blephariglottis blephariglottis, Willdenow*

The white fringed Orchid is a very rare plant in Aroostook County. I found one plant on Eric Olsson's farm in New Sweden, in July 1904. Three fine plants were collected at Salmon Brook Lake in Perham the first week in July, 1907; and at Large Mud Lake, located in Westmanland and Perham, the last week of July, 1917, I collected in full bloom, a hundred or more of these very beautiful flowers.

THE PRAIRIE WHITE FRINGED ORCHID

*Blephariglottis leucophaea, Nutt.*

This plant is, to my knowledge, found only at the big bog at Crystal Station, where I found some in 1904

SMALLER PURPLE-FRINGED ORCHID

*Blephariglottis psycodes, Linne*

I have collected this orchid on Temicouata Lake, Province of Quebec, August 1, 1913, where it is quite common. It is also found on the Tobeque River in New Brunswick.

LARGE, OR EARLY, PURPLE-FRINGED ORCHID

*Blephariglottis grandiflora, Bigelow*

The plants collected by my friend, Philip Phair, Esq., on the Presque Isle stream were very large and should be referred to this species.

*Blephariglottis andrewsii, White*

A plant collected at Moose River, Somerset County, Maine, August 1, 1914 would correspond with this plant. The fact is the purple-fringed orchid is very variable according to its locality and is difficult to specify.

ROSE POGONIA; SNAKEMOUTH

*Pogonia ophioglossoides, Linne*

This is a rare plant with us, six flowering plants were collected on July 17, 1921. This colony has flowered twice in thirteen years. I presume that the warm and dry summer has been just right for this plant this year.

ARETHUSA; DRAGON-MOUTH; WILD PINK

*Arethusa bulbosa Linne*

On June 24, and July 12, 1904, I collected a few specimens in New Sweden, on the west side of Fogelin Lake. This same locality was visited again on June 23, 1920 and about 100 plants were observed. While collecting on June 29, 1921, at Salmon Brook Lake, Perham, I found 3 flowering plants.

GRASS PINK, CALOPOGON

*Limadorum tuberosum, Linne*

My attention to this plant was first called by Nels Grill and in his company I have collected these plants in small numbers several times on the east side of Mud Lake, located in Westmanland and Perham, between July 12 and 20.

LADIES' TRESSES

*Ibidium cernuum, Linne*

I have collected plants that I referred to this species, but some of the authorities informed me that it did not grow so far north, so I am glad to record that my friend, Frank C. Merritt, has collected the same at Houlton, Maine, between the years 1894 and 1910.

*Ibidium Romanzoffianum, Cham.*

A very widely distributed plant, flowering from the last week in June until killed by frost in the last part of September. Its sweet-scented, white flower is admired by all. Most common in bogs and low grass-land.

*Ibidium gracilis, Bigelow*

Is found near Dover, Maine, and collected by F. C. Merritt in the summer of 1916.

TWAYBLADE

*Ophrys cordata Linne*

The habitat of this plant is in the low, flat ground in the cedar swamps where it is often quite abundant. It blooms in the first part of June in Westmanland, Perham and Woodland.

*Ophrys auriculata Wiegand*

This plant is very rare and I have only seen it once some years ago on the west branch of Caribou stream in Woodland.

*Ophrys convallarioides, Sw.*

Is well distributed and very abundant some years in wet places in woods and near streams, New Sweden, Woodland and Perham, and flowers from the 20th of June to August.

RATTLESNAKE PLANTAIN

*Peramium pubescens, Willdenow*

This, the large rattlesnake plantain, is not native to the north of Maine, but I have it growing in my woods on my farm in Woodland where it seems to thrive. The plant was sent to me by Miss Inez Addie Howe of St. Johnsbury, Vt.

*Peramium repens Linne var. ophioides, Fernald*

This small plant is found in wet, mossy places in the spruce woods. The leaves are dark, velvety green with light fine markings, and very beautiful. In bloom July, August and September. New Sweden, Woodland and Perham.

*Peramium tesselatum, Loddiges*

The leaves are dark green, mottled with white or light green, very variable. This rattlesnake plantain is distributed in the mixed forests over the north of Maine, New Brunswick and Quebec. Flowers in July and August.

*Peramium Menziessi, Lind., P. dicipiens, Hook*

The largest of the rattlesnake plantains. The leaves are dark, mottled with light green along the center, from two to three and one-half inches long. Stem, 10 to 12 inches and spike of sweet-scented flowers, two to four inches. I have found two large patches with about 235 plants in New Sweden, near the Capitol, 1904. In Perham I have found it in four different places and about 300 plants, and a few single plants in Woodland, habitat near the top of hills in mixed forests of spruce, hemlock and some hardwood. In Quebec, on Mt. Wissick, Temiscouata Lake, in August, 1913, I observed a number of these plants, but they were smaller than those I have found in Aroostook County. All the rattlesnake plants were common on Mt. Wissick. They are in flower in July and August.

THE GREEN ADDER'S-MOUTH

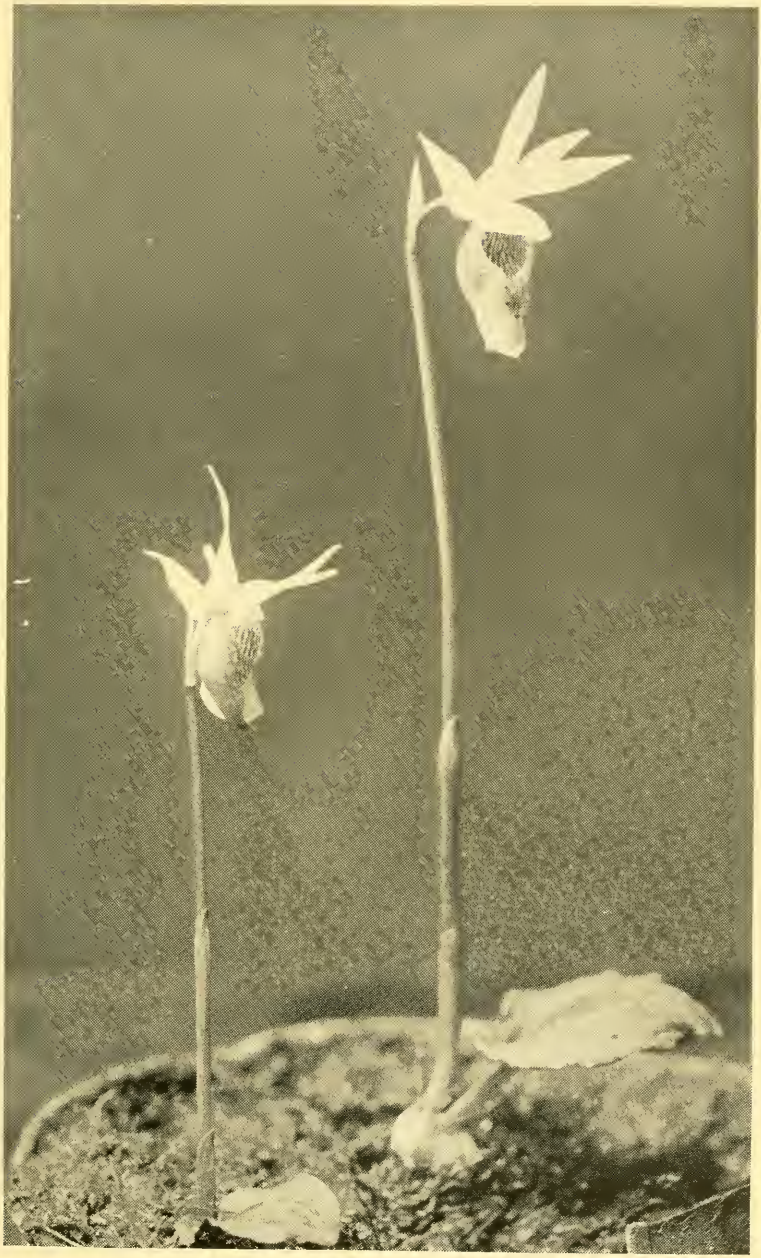
*Malaxis unifolia, Michaux*

I have only observed this plant in Perham in the north and central part of the town. Flowers from July 10 to August 10. The height of the largest plant I have is 7 1-2 inches, and one of the plants collected has two leaves on the center of stem. The flowers are minute and very numerous and have to be studied under the microscope.

CALYPSO

*Cytherea bulbosa, Linne*

Among botanists, C. bulbosa is considered one of the most beautiful and rare plants. Sometimes I find a good number of these plants in the cedar swamps on the headwaters of Caribou stream in New Sweden, Woodland and Perham. Among the orchids it is the first one to open and I have collected it the first week in May, or as soon as the snow is off the ground, on my farm in Woodland in full bloom; and I have sometimes found flowers the first week in July. This is the most enduring flower I have seen. Sometimes I have had them standing in a little damp moss in my room for three weeks before they have begun to wither, and any ordinary frost, common with us in May and June, seems to have no effect on them.



Cytherea bulbosa

Cytherea bulbosa

LARGE CORALROOT

*Corallorrhiza maculata Raf.*

Often seen in the hardwood ridges in New Sweden, Woodland and Perham. Flowers in June and July.

SMALL CORALROOT

*Corallorrhiza trifida Chatelain*

Habitat in low, wet places. Flowers in last week of May to July. This is a very peculiar plant as it appears in profusion some years and then for several years I am not able to find any. In the month of June, 1918, they were very common on the hills in Perham and New Sweden.

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"I am much interested in the literature you sent me and am glad to become a member of the Knox Academy. I cannot attend the field meeting this year, but hope to do so some other summer. I trust that in your campaign for members you have not neglected the great army of summer residents, many of whom love the Maine woods and shores as much as those who are fortunate enough to be 'Mainiacs' all the year round. I notice that few of them can help catching the infection of nature study."

—Prof. D. P. Lockwood
of Haverford College, Pa.

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"I beg to acknowledge with many thanks the receipt of a copy of Vol. 1, No. 1 of the Maine Naturalist. May we not extend to you most hearty congratulations on the appearance and substantial and interesting character of the first number of this new serial. This is a difficult time in the world's history to launch a new publication on account of the high cost of paper and printing, and your first number certainly gives evidence of a very lively and vigorous organization back of it."

—C. Stuart Gager,
Director Brooklyn Botanic Garden.

## THE FLORA OF THE STATE OF MAINE

By Louise H. Coburn

Prof. Sereno Watson, long time curator of Gray Herbarium, used to say, when questioned about some plant not recognized in the Manual, or recorded with a range which excluded Maine, "Oh, anything can be found in Maine." Since Prof. Watson's day a large amount of research has been devoted to the flora of Maine, and there is a much better understanding of it than he ever possessed. To illustrate the advance of our knowledge in this particular limited segment of science, the Portland Catalogue of Maine Plants, published in 1868, contained 1107 species and varieties, and the second edition of 1892 contained 1410, while at present the number of species and varieties recorded as growing naturally in the state is about 2000.

The position of the state of Maine is favorable to a varied flora. It extends north and south over 4 1-3 degrees of latitude, or 300 miles, and east and west over 4 1-6 degrees of longitude, or 285 miles. The 45th parallel, central between equator and pole, crosses very nearly the middle of the state. From this medial station Maine regards impartially the pole and the equator, and its flora has both boreal and austral aspects. In the forests of northern Somerset may be found the Banksian pine, a boreal species, which reaches within one and a half degrees of the arctic circle, while in York County grows the white cedar, a tree of southern swamp-lands, and the sassafras, also an austral species. The central part of the state marks the northern limit of many southerly species, and the southern limit of many northerly ones.

While the southern part of Maine is low and in general level, the interior gradually rises to high uplands, set thickly with hills, and intersected by rivers. There are six long interior rivers, and eight seaboard rivers, which drain 1620 lakes. These figures, however, respect only outstanding features, for there are over 5000 rivers and streams, there are thousands of ponds, and there are hills without count or name, a good number of them entitled to be called mountains.

The surface of Maine is geologically varied, and in this respect favors a variety of plant growth. A large portion, especially of the northern part of the state is strewn with granite boulders, often with a bed of gravel underneath, thinly coated with vegetable mould. Other portions have granite or slate ledges, outcropping or thinly draped. Large

areas of central and southern Maine are sand-plains, and sand-hills, which were originally covered with white pine forest. Sand and clay are alternated along our highways. With the acid soil of countless bogs and of granite hills, there is lime enough in some regions, especially on parts of the coast, to satisfy the most exacting calciphiles.

The whole northern half of Maine is swept by the so-called Canadian forest, whose dominant trees are fir, arbor vitae, and the spruces. The central and southern parts had originally great stands of white pine, occupying the sandy places and more fertile ground as well, alternating with rich deciduous woods, of which the typical trees are yellow birch, rock maple, beech and white ash. To this eastern deciduous forest and the pine associated with it has been given the name of Alleghanian forest. In the middle part of the state these two great forest systems alternate or are mingled, according to the conditions of altitude and soil in each locality.

In the mean time some species of the Atlantic coastal plain flora come up into the southern beaches and woods of the state, and touch some of the islands which are the ancient hills of the submerged coastal plain of Maine, on their way to their northernmost outposts in Nova Scotia. These represent the Carolinian flora of the great eastern coastal plain of the country. There are more than 400 islands off our coast containing 11000 acres and over, besides innumerable smaller ones, and upon the seaward cliffs of many of them may be found plants of this coastal plain flora, stragglers from the southward. These numerous islands, and a tidal coast line of 3000 miles which represents a straight ocean border of 226 miles, give to Maine a seaside nearly equal to the combined Atlantic and Pacific shores of the United States, and a seashore flora of conspicuous importance.

While the Carolinian flora steps into the edge of southern Maine, and touches lightly the seaward islands, the coast of Washington County, the upper part of the ocean border of the state, exposed to the cold winds and fogs and icy waters of the Labrador current, harbors a northern or Hudsonian flora, as it is called, and even subarctic and arctic plants, characteristic of the far north. Boreal species are found again upon our higher mountains, Katahdin, Abraham, Bigelow, and others. The upper slopes of Katahdin, which is said to be distinctly more arctic than Mt. Washington, bear an arctic—alpine flora. By what seems like a strange floral affinity this same arctic-alpine flora is also found on

the borders of our cold ponds, relics of the retreat of the glaciers, and in the sphagnum bogs, which represent a later life stage of such ponds.

Besides the variety of our flora already spoken of, each great river valley has its individuality, and some species and varieties which do not transfer from valley to valley. The valley of the St. John especially has a flora interestingly individual. The slate ledges of some of our rivers are sufficiently calcareous to attract some calciphile species.

In addition to our indigenous flora, there are a large number of introduced plants. Plant immigration began with the first settlers, who in compliance with the conditions of their grants were obliged to clear some acres for English grass. Many of our common flowers of field and roadside, such as dandelion, buttercup, and the clovers, came in with the English grass-seed, and with the turnip, cabbage, and beans of the garden arrived pigweed, chickweed, plantain, and other similar migrants, the first instalment of our weeds. Ever since the time of the pioneers, Europe has been constantly shipping us her wastrels, down to the orange and yellow hawkweed of recent years, the farmer's detestation. With the advent of western hayseed, many plants of the prairies found their way in, like the black-eyed Susan. The number of naturalized species is large, and they make up the body of our field and a considerable part of our roadside plants. They occupy a more conspicuous place in the landscape than they have any right from the number or importance of their species to claim.

Some of the reasons for the variety and interest of our flora have been sketched. Maine possesses mountain and valley, lowland and upland, sea-shore and lake-border, river-bank and brook-side, bog and meadow, pasture-land and intervale, ledges of granite, slate, sandstone and limestone, gravel, sand and clay, acid, neutral and basic soils, and thus affords a variety of environment for a large and varied flora.

So we have our state of Maine, with its territory occupied by two great armies of the plant world, with its northern and southern borders held by the rear-guard and the vanguard of two other great armies, and with its gates wide open to unrestricted immigration, even to hoards of undesirable aliens. Surely we may amend Prof. Watson's remark by prefixing one letter, and adding another to the second word, and say truthfully when speaking of the flora of our state. "Many things can be found in Maine."

# BOTANICAL NOTES AND NEWS

## JOSSELYN BOTANICAL SOCIETY OF MAINE

The Josselyn Botanical Society held its field meeting for 1921, July 12 to 15, at Brunswick, with headquarters at McLellan's Inn. About twenty members were in attendance. Excursions were made to Cathance River, Merry Meeting Bay, Woolwich, Winnegance Creek, Phippsburg, Small Point Beach, and Bald Head. Weather favored, and the days in the field were much enjoyed. The salt-marsh and sea-beach flora proved very interesting, especially to members living inland, and a few plants special to the locality were found.

Evening business meetings were held in the Bowdoin Science Building, with Prof. Alfred O. Gross extending the courtesies of the college. At one of these sessions Mr. Ralph C. Bean gave an account of his botanizing trip to Nova Scotia last year, and at another Dr. Susan P. Nichols described the species and relationships of the fresh water algae.

Greetings were sent to Dr. Dana W. Fellows, retiring president, and to Miss Kate Furbish, with regrets that they were unable to be present. Officers were elected as follows:

President—Mr. A. H. Norton, Portland.
Vice-President—Mrs. Jennie M. Morrell, Gardiner.
Secretary—Miss Lena Willis, Naples.
Treasurer—Mr. R. C. Bean, Wakefield, Mass.

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## MAINE ORCHIDS

Many readers of the Naturalist have no doubt been interested in Mr. Nylander's description of the Orchids of Aroostook County. People who are accustomed to think of Orchids as inhabitants of tropical jungles are often surprised to learn that there are many species which prefer a northern climate, and which thrive in cold bogs or in wet Maine woods. Will not the botanists throughout the state send lists of the Orchids that grow in their vicinity to the editor of this department? Do not describe them, but tell in what towns and in what sort of environment you have found them, whether they are abundant or rare, with any other special note. Make use of the names you are familiar with. The editor of this department would like to receive such a list from every county in the state. Let us see which county will first get ahead of Aroostook in the size of its list.

## HEATHER IN NEW ENGLAND

By John H. Lovell

The heathers are not native to America, but two species are found in small patches on the island of Nantucket; and Scotch heather occurs in low grounds along the coast from Newfoundland to Rhode Island. In northern and western Europe heather, or ling, covers vast areas of waste or sterile lands called moors. When it grows a yard tall, the small evergreen leaves, the purple stems, and profusion of white or pink flowers present an expanse of color long to be remembered. Its uses among the peasants are numberless, being employed for brooms, brushes, baskets, fuel, brewing, roofing, beds, dyeing and fodder. Another beautiful heather, the purple heath (Erica cinerea) is also common on the lower moors of Great Britain. Both secrete nectar plentifully and furnish a generous surplus of amber-colored honey, with an aromatic flavor, and a pungent aroma, but so viscous that it is difficult to extract. In southwestern Africa the heaths reach their maximum and the 500 species are a prominent element in the vegetation of that region, reaching the height of 12 feet and being covered with white or pink blossoms for a large part of the year.

On an estate at South Lancaster, Mass., there have been planted on the hillsides in irregular masses two or three acres of heather (Calluna vulgaris.) The plant is hardy and seeds itself, but it is necessary to keep the land free from underbrush. It is propagated by means of cuttings rooted in a greenhouse. The original seed came from Scotland and was planted at Townsend, Mass., by a Scotch woman, homesick for her native heather hills. No surplus of honey has thus far been obtained from the bloom.

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In each issue of this journal beginning with the April, 1922 number, we plan to publish a short account, with photographic illustration of some remarkable tree, noted for size, age or historical association. We herewith solicit photographs, cuts, and short descriptions of such trees now standing within the boundaries of Maine.

HEATHER (Calluna vulgaris)

NATURAL SIZE

Flowers from the Thayer estate, South Lancaster, Massachusetts

## DEPARTMENT OF FORESTRY

Editor } Prof. John M. Briscoe, Orono

### THE WHITE PINE BLISTER RUST

*(Cronartium ribicola Fischer)*

By John M. Briscoe

Of all the parasitic fungi, that known as the White Pine Blister Rust is giving most concern to foresters and naturalists at this time. This is so, not because it threatens the present crop of mature or nearly mature white pine, but because it jeopardizes the future of this valuable timber tree species.

The fatal results of this disease are being found in increasing abundance throughout the natural range of the white pine in the northeastern states. It is also established over a large area in Wisconsin and Minnesota.

The fact that the disease is fatal to young pine is beyond dispute. Convincing evidences are all too abundant at the present time, and may easily be inspected by anyone who is at all inclined to be skeptical as to the actual damage done by the disease and its effect on the trees attacked.

The native pines are fast becoming generally infected. Extensive surveys by the Bureau of Plant Industry showed that 16 per cent of the trees examined were already diseased. In addition there are local areas in Maine, New Hampshire, Massachusetts, and New York where the infection now runs from 33 percent to 67 percent of the present stand of young pine, and trees completely girdled and killed by the disease may be found up to as much as 10 inches in diameter. Some of these areas are of wide extent.

After looking over a single one of the many badly infected areas where the disease already has obtained a firm foothold, no one will doubt the damage that can be and is already being done to our future crop of this most valuable species.

Undoubtedly more has been written on the value of the White Pine for this region than on any other species. Advice for obtaining future crops both by natural regeneration and by planting has been given and is still being given in abundance; but all such efforts will be rendered futile if provision is not made for the eradication of all species of currants

and gooseberries, both wild and cultivated, from within and about the areas to be regenerated to a distance of about three hundred yards, under ordinary conditions. All of these species, generally known as "Ribes," must be kept out of all areas growing White Pine.

Fortunately this work of eradicating wild currant and gooseberry bushes is practical and provides an effective method for the control of this disease. In fact, experimental work already done by the Bureau of Plant Industry in co-operation with the several States, shows conclusively that eradication is not only economically possible, but produces positive results in stopping the progress of the disease, as shown in sample plots at Kittery Point and at Alfred, Maine. In both cases eradication was done in 1917, and no new infections have been found since that date on either of these areas.

Blister Rust enters the tree through the leaves or needles, and the disease works slowly down through the leaf tissues and the cambium, the fruiting stage occurring as long as four years after the original infection has taken place.

It is a parasitic plant which lives in its alternate stages in the inner bark of white pine trees and in the leaves of all known kinds of currant and gooseberry bushes. It is but one of a large number of parasitic fungi or rusts, such as the Wheat Rust, which has its alternate stage on the barberry, and the Apple Rust which has its alternate stage on Cedar. Without the two different plant hosts to live on, they can not complete their life cycle and therefore they die without spreading. It can not go directly from one pine tree to another, without the intermediate stage on some species of Ribes.

The rust is most easily distinguished on pine from the middle of April to the middle of June, when it shows up as orange-yellow blisters on the bark of the pine. These blisters are filled with fine dust-like spores, which are carried by the wind to great distances, where they germinate on the under surface of the leaves of either currant or gooseberry bushes. The diseased areas in the bark are surrounded by a discoloration of a yellowish or bronze tinge, and later in the season the injured bark cracks up in irregular fissures and plates.

The leaves of the currant and gooseberry again produce bright orange-yellow spores about ten days after infection, on the under side of the leaves. This constitutes the early summer stage of the disease on Ribes, and the spores pro-

duced then will spread rapidly to other Ribes. About the first week in July the second or late summer stage begins to appear on the infected Ribes. This stage is recognized by the dark brownish or dark orange colored columns or horn-like structures on the under side of the leaves. The spores produced at this time, known as "telia" are the ones that infect the pine. They can not travel as far on the wind and remain alive, as the spores produced on the pine, so the radius of infection is reduced or limited to a distance which makes economic control possible.

While the spores from the pine may be carried for great distances by the wind, possibly ten to fifteen miles or more, they may also be carried by other agencies such as insects, animals or man. They will retain their vitality for several weeks and grow wherever they happen to fall on currant or gooseberry leaves.

The spores from the Ribes leaves, however, are more delicate and apparently of less vitality. They do not seem to be able to thrive if carried for more than at most a third of a mile and usually the distance is less than three hundred yards. This accounts for the difference in distance between the spread of the rust from the trees to the bushes, and from the bushes back to the pine, as has been clearly demonstrated by carefully planned and scientifically conducted experiments.

Hence, wherever the currant and gooseberry bushes have been removed from the vicinity of the pine, the further spread of the disease is absolutely stopped. The low cost of efficient eradication averaging from 24 cents to 35 cents per acre over large areas, makes this insurance well worth while, and the owner may feel sure of a commercial stand of white pine, in so far as the damage from blister rust is concerned.

Some people still believe that the blister rust is not a serious menace to the growing of white pine, but their judgment is not in accordance with the facts at hand, and is usually based on insufficient or inconclusive evidence.

It is not at all necessary to become unduly alarmed about the present mature crop of white pine, but it is good business policy to remove all Ribes from areas where young pine is now growing or where it is to be grown for the future. The State Forester in every state is ready and willing to cooperate with the private owner in this work and to offer all possible aid and assistance.

The White Pine (Pinus strobus, L.) is the only native species in the East that is susceptible to the disease, but

since the blister rust may infect all species of five-needled pines, and since some of these are grown ornamentally, a list of all of these pines is appended, as shown in Farmer's Bulletin No. 742 United States Department of Agriculture. This bulletin is illustrated and gives detailed descriptions of the disease, and the early history of its occurrence in this country. More recent information on the control of the disease can be obtained from the State Forester.

The White Pine Blister Rust has already gained such a hold in the eastern part of the United States, that its elimination from generally infected states is out of the question. It is here simply a matter of local control by eradication of Ribes.

All efforts are now being made to hold it there, and to prevent its introduction into the extensive five-needled pine forests of the Rocky Mountain and Pacific Coast States, where on account of the larger number of native Ribes and five-needled pines, its possibilities for damage are almost incalculable. On the National Forests alone, it might necessitate the elimination of the very species of the greatest economic importance and most desirable in the practice of forestry in that region. The disease is not present west of Minnesota and cannot spread naturally across the treeless Great Plains region. It can only reach the Far West on shipments of diseased nursery stock and hence the Federal Government has prohibited the movement of White Pine and Ribes from states east of the Mississippi Valley quarantine line to points west of the line. This quarantine of all pines and Ribes must be rigidly enforced and it is to the interest of all to help maintain it effectively.

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The scientific and popular names of the 5-needle pines of the world, exclusive of the different varieties, are here given for the convenience of nurserymen and others who may wish definite technical information; American.—Pinus strobus, white pine; P. monticola, western white pine, P. lambertiana, sugar pine; P. flexilis, limber pine; P. albicaulis, white-bark pine; P. strobiformis, Mexican white pine; P. balfouriana, foxtail pine; P. aristata, bristle-cone pine; P. cembroides, pinion pine. Foreign.—Pinus excelsa, Himalayan white pine; P. peuce, Balkan pine; P. armandi, Chinese white pine; P. parviflora, Japanese white pine; P. cembra, stone pine; P. koriensis, Korean pine. Some of the more important varieties which are included in the foregoing species are Pinus nepalensis, P. scipioniformis, P. mastersiana, P. pentaphylea, P. morrisonicola, P. formosana, P. pumila, P. mandschurica, P. sibirica, and P. coronans.

Alfred, Me., 13 August, 1921.

## DEPARTMENT OF GEOLOGY

Editors { Prof. Edw. H. Perkins, Waterville
C. Vey Holman, Rockland

### POSSIBILITIES OF TIN MINING IN MAINE

By C. Vey Holman

Of all the metals commercially used in economic quantities, none is of commoner or more widespread employment than tin. From the first toy rattle of the babe, up through the interminable line of indispensable articles of culinary and other domestic use, and the vast world of cans, boxes and similar containers for food-products, oils, paints and other liquids requiring hermetic sealing and nonleakability for their safe preservation, convenient handling and freedom from contamination, as well as the limitless sphere of industrial alloys including bearing metal and solders, in the composition of which it is an indispensable ingredient, tin presents itself as a factor of universal usefulness to man.

Yet most people, including even those who are intimately connected with the management of industrial concerns consuming tin in enormous quantities, know little of the nature of the metal, its source of origin, methods of production, or its true value as an indispensable factor in the modern business world's scheme of assembly, storage and distribution of food and other supplies.

Still fewer know or realize that although tin has been in common use since prehistoric times, the sources of supply of the metal, in the form of mineral deposits have ever been extremely limited and that, though the world has been ransacked since the days of the Phoenicians by skilled and daring miners of every race, commercial supplies of tin are today, as for thousands of years they have been, drawn from practically but three localities, Cornwall in England, the Malayan peninsula and islands in Asia, and Bolivia in South America. From what sources were drawn the tin mentioned by Old Testament writers and the greater portion of that the use of which in alloy with copper characterized that earlier period of human industrial development known as the Age of Bronze, must always remain the subject of speculation, and its consideration here would be purely academic.

We know that the Phoenicians of remote antiquity and their children, colonists and trading successors, the

Carthaginians, obtained tin from islands mysteriously denominated the Cassiterides which they reached by sailing out of the portals of the Mediterannean, past what they called the pillars of Hercules, the Northern member of which we know as the Rock of Gibraltar, and far northward across the Bay of Biscay, these Cassiterides are identified by many writers as the Scilly Islands but it is at least open to conjectural belief that the triremes of Carthage reached the shores of Cornwall and drew thence their supplies of tin, the sources of origin of which mighty Rome vainly endeavored to discover.

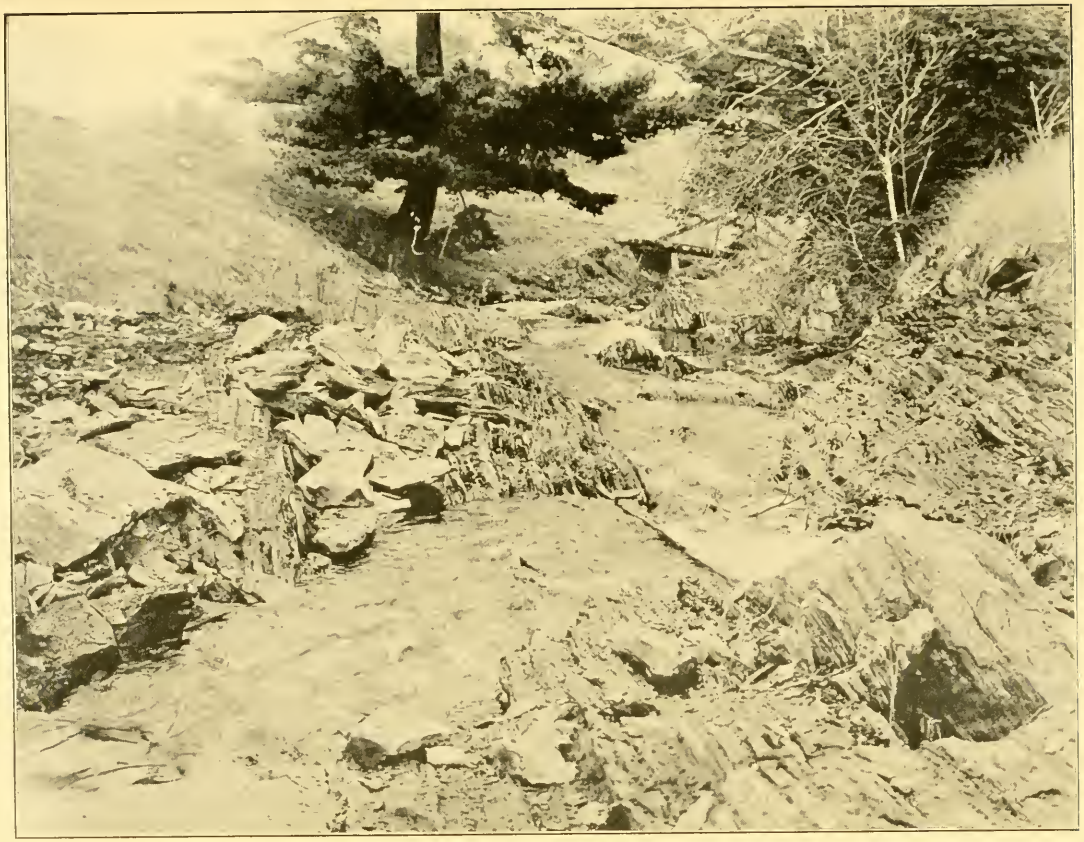
That tin was known and industrially employed very early in the history of both Babylonia and Assyria has been proven by the discovery in excavations made in those countries of bricks and vases covered with white enamel derived from tin oxide. The same peoples used copper to produce a blue enamel. But the mine sources from which they drew the tin employed remains, and in all probability will ever continue, an impenetrable mystery.

The North American continent has so far failed to produce a tin mine of commercial importance and this, despite the fact that the United States is today the world's largest consumer of the metal, tin, and by far the world's largest manufacturer of tin products.

The critical significance of this situation was sharply brought home to officials of the Government and to executives of concerns controlling the manufacture of tin cans and similar containers during the world war when military restrictions placed upon the handling and export of the metal by tin producing countries suddenly threw into startling relief the fact that every pound of tin used in the United States for any purpose was derived from foreign sources of supply, and could only be gotten into the United States through ocean borne carriage, involving trans-atlantic or trans-pacific voyages.

Every geologist who has studied the rock formations of Maine with care and expressed himself upon the subject has entertained the belief which I heartily share that somewhere within the boundaries of the State there lies and will eventually be revealed a tin-bearing deposit capable of yielding a commercially economic supply of that most useful metal, tin.

As early as 1835, Dr. Charles T. Jackson, eminent in the profession, and my earliest predecessor in the office of State



DRUMMOND BROOK, WINSLOW, MAINE

In the bed of which occur numerous veins of tin ore

Geologist of Maine, in his report to the legislature called attention to the occurrence of wolframite in the granites of the Blue Hill region as an indication of the probable presence of tin and recommended that search be made for it.

The existence of sporadic pockets of cassiterite (the only commercial ore of tin) in the tourmaline bearing rocks of Hebron and Paris Hill is thoroughly established but its presence has so far been but sparingly demonstrated and the search for it has probably been entirely subordinated to the mining for those rarely beautiful and valuable specimens of gem tourmaline which have made these localities world-famous. Some of the individual crystals of cassiterite from Paris Hill have equalled in size and lustre any that I have ever seen from the larger tin-fields of the world.

Throughout a large portion of the granite matrix of the vast molybdenite ore-body developed by myself at Catherine Hill, in Hancock County, there occurs a dissemination of minute cassiterite crystals and I have singly and in collaboration with that wonderful chemist, the late Dr. Ora Willis Knight, reduced metallic tin from crushed samples of this rock, but, of course, only on a laboratory scale and upon a far from economic basis.

The only serious attempt to develop a tin mine in Maine was made on Drummond Brook in the town of Winslow, three miles below Waterville, in Kennebec County.

Some half century ago, a returned California miner by the name of Charles Chipman noticed a series of quartz veins carrying unusual minerals crossing the bed of this brook. With the cooperation of Daniel Moor, of Waterville, he opened a small prospect pit on the bank of the brook and soon learned that among the unusual minerals carried by these veins was cassiterite, the only commercial ore of tin, in the form of dark brown and black lustrous crystals, much higher in specific gravity than the associate minerals in the gangue matter of the veins.

Nothing of note occurred, however, until, in the year 1880, Dr. Augustus Choate Hamlin, a distinguished citizen of Bangor, an authority on gems and gem mining, and the principal owner of the celebrated tourmaline mines on Mt. Mica, organized a corporation known as the Maine Tin Mining Company and began sinking a shaft on the site of the old Chipman prospect pit. Associated with Dr. Hamlin in this company were a number of well-known citizens of Kennebec and Penobscot counties and the actual shaft sinking

operation was under the direction of a celebrated mining engineer, C. W. Kempton, who for many years maintained engineering offices in New York City.

Unfortunately, the inception of this enterprise coincided with the general and disastrous collapse of the mining industry of Maine when the copper producing mines at Blue Hill and the silver mines of Sullivan, in Hancock County, were forced to abandon all their activities owing to the world wide depression in the markets for these metals following the financial failure of the French syndicate headed by Secretan, the ambitious promoter who at one time nearly succeeded in his effort to secure control of all the copper mines of the world.

These circumstances, coupled with the fact that the corporation, though capitalized at half a million of dollars, was most slenderly financed, never, in so far as I am able to learn, having had as much as five thousand dollars in actual cash funds, make it easy to understand why the enterprise came to an early and untimely end. In truth, it is surprising that so much was actually accomplished in the short period of the company's operation. As it was, a two compartment shaft, well timbered and equipped, was sunk to a depth of one hundred feet on the mineralized belt of rock carrying the tinbearing veins. Of course, no ore bodies were blocked out and so the presence or absence of commercially minable tin was never conclusively demonstrated.

During the years, following the discovery by Chipman, down through the period of activity of the obsolete Maine Tin Mining Company, the locality was visited, examined and reported on by many of the leading mining geologists of America, none of whom ever disputed the contention that the dozen or more veins crossing the brook carried tin ore (cassiterite) in association with the unusual group of minerals characteristic of and invariably accompanying tin in the other tin fields of the world. These accessory minerals, in the order of their importance, ranked in accordance with their chemically accepted significance as influencing the deposition of tin, are fluor-spar, tourmaline, the peculiar micas known as margarite and lepidolite, beryl, and galena or silver-bearing sulphide of lead. All these and other associate minerals, products of fluid or gaseous emanations from deep seated magmas, evidencing metalliferous deposition under conditions of extremely high temperatures and great pressures, are found in abundance in the veins at Winslow. The veins themselves, all observers have concurred in saying, are true fissure veins, varying in width from an inch to a

foot or more, traversing a series of sedimentary beds of mica schists and limes, high in calcium carbonate content, which constitute the country rock of the region round about Winslow for many square miles. These sedimentary shales and schists, originally, of course laid down in approximately horizontal layers were, during the mountain building period of their geologic life, tilted up on edge, until they now stand nearly vertical.

Following this upheaval they were intruded by two series of younger rocks—namely, first the tin bearing veins which follow very nearly the general course of the stratification of the sedimentaries, though occassionally cutting sharply across them; and, secondly, massive igneous dikes closely paralleling the strike of the veins, and possibly intimately connected genetically with the tin veins. These dikes are called in Cornwall, the oldest tin mining region of which we have contemporaneous knowledge, 'Elvans' and are regarded by Cornish miners and mining geologists as indispensable and infallible companions and guides to true tin-bearing veins. It is rudimentary knowledge in Cornwall that if these 'Elvans' and the tin-bearing veins meet or cross or intersect one another in their course across the country or in the dip beneath the surface, enormously enhanced richness of metal content either in tin, tungsten or silver, may be confidently predicted. Such elvans occur in close proximity to the Winslow veins on which the hundred foot shaft was sunk.

In the course of exploratory work on this deposit which I have been conducting for the past three years, I have traced the principal elvan or dike from a farm in Sidney at a point several miles south of the tin deposit and on the opposite bank of the Kennebec River, northeastward till it plunges beneath the water on the Sidney shore, crosses the river and emerges on the Winslow shore, continuing straight on until it crosses Drummond Brook within a few feet of the tin veins and the old shaft. Thence it runs northeast to a point on the east bank of the Kennebec just below the Winslow end of the Waterville bridge, from which it may be plainly viewed by any passerby.

Reference has been made to the significance attached by Cornish miners and mining geologists to the "Elvans" or dikes of trappean rocks, paralleling the tin veins in that region, famous during so many centuries as the world's greatest centre of tin mining.

De la Beche, the greatest authority on the geology of Cornish tin deposits, lays especial stress on their importance.

It is interesting to compare the views of a prominent American engineer, Courtenay De Kalb, who, in an article published in the Engineering and Mining Journal in June, 1888, dealt with their occurrence and probable influence upon the deposition of cassiterite in the Appalachians in Western North Carolina. "The paragenesis of cassiterite in the Appalachians is such as to induce strong suspicions," he remarks, "that it may be found in workable deposits somewhere in the chain. I have heard of no case of its occurrence in greison or in the granite series of the region, but always in quartz veins in close proximity to basaltic dykes. The quartz, which is invariably full of cavities is strongly impregnated with mispickel, and has associated with it topaz, apatite and sometimes considerable amounts of fluor-spar. The occurrence of minerals containing fluorine in the neighborhood of trap dikes is an indication of the probable existence of tin in the same locality * * * * This association of tin bearing rocks with basalt finds an explanation in the discovery of Daubree that fluoride of tin is volatile at a high heat, but is readily decomposed in contact with other substances, resulting in the formation of other fluorides, while stannic oxide is set free. An eruption of basaltic lava would provide all the conditions for the volatization and escape of fluoride of tin, and for the deposition of cassiterite in fissures nearer the surface. Of course, this applies only to tin ore in true veins, but in the Appalachians, where this is the prevailing condition, a knowledge of this relationship may be helpful in leading to important discoveries."

Remembering that the Kennebec Valley lies in the region of the northern Appalachians and that all the geologic conditions and mineral occurrences mentioned by Mr. De Kalb are in evidence at Winslow, one may be pardoned for accepting his conclusions.

Before leaving the subject of the chemistry of tin deposition, it will be of value to compare the well-founded theories of the great French scientist, Daubree as so briefly out lined by De Kalb, with those of an eminent English geologist, Donald A. MacAlister, Esquire, F. G. S., who in a paper on "Tin and Tourmaline" read before the Geological Society of London in 1903, remarked:

"Cassiterite hardly ever occurs without tourmaline, although the latter is found without the former; hence it appears that tourmaline-producing constituents and influences are of wider range than are those of cassiterite. Boron trioxide is an extremely common accompaniment of volcanic action and there can be no doubt that it has acted powerfully

OPEN CUT IN WINSLOW TIN MINE

Driven by C. Vey Holman, realizing new tin veins and elvans

in changing such original minerals as the micaceous and felspathic ingredients of crystalline rocks. From a comparison of formulae representing tourmaline and felspar, it is evident that the act of tourmalinization has been accompanied by a loss of soda (which alone is capable of action on tin.) The excess of boric acid( which is over and above that required for tourmalinization) will combine with this soda, forming metaborate and pyroborate of soda.

"The former, acting on disseminated tin ore, might result in the production of sodium-metastannate and borax. The soluble meta-stannate is capable of being leached out of the magma, and, by a new reaction, tin oxide may be precipitated and concentrated, sodium metaborate being liberated."

Again is to be remarked, in connection with this highly scientific hypothesis of origin of tin ores, that at Winslow are to be found in abundance all the necessary ingredients to produce the chemical reactions described by MacAlister. The presence of fluorine, boron, and tourmaline in profusion in all the rocks of the Winslow series constitutes one of the out-standing features of the mineralization there. And they undoubtedly have exercised great, possibly predominant, influence in causing the precipitation of the cassiterite crystals or tin ore of the veins.

Among early visitors to the Winslow tin deposits was the great Canadian mining geologist, T. Sterry Hunt, who, in 1873, in an address read at the Boston meeting of the American Institute of Mining Engineers of which he was then President, referred to them in these words:

"The White Mountain series in the Appalachians * * * * abound in copper and have, moreover, yielded the only traces of tin ore as yet known to us in Eastern North America. It is with the gneisses and micaschists of this series that cassiterite has been found in Massachusetts, New Hampshire and Maine in concretionary aggregates with tourmaline, beryl, micas, feldspars, fluorspar, et cetera, recalling the associations of the tin ores of Europe. At Winslow, in Maine, the veins traverse a micaceous limestone which, I conceive, belongs to this series * * * The veins, which are seldom more than an inch or two in thickness are abundant through a considerable breadth of the rock, and are interlaminated with it, occupying places between the sedimentary layers, which are distinctly marked by different shades of color. Occasionally, however they cut across the stratification for a little distance, showing that the disrupting action was

not always confined to tearing the layers apart. The vein-stone consists of purple fluor-spar and silvery white mica with quartz. In this gangue, the cassiterite, nearly black in color, is disseminated in small crystalline masses, sometimes one half an inch in diameter and is associated with a little mispickel."

At the time the Maine Tin Mining Company was operating the Winslow tin deposit, Dr. Forrest Shepard, of Norwich, Connecticut, a geologist of high standing in both Europe and America, and familiar with the Cornish deposits, conducted an extended examination of the property and made a remarkably enthusiastic report upon it, from which I extract a few sentences, showing his concurrence with the conclusion of Dr. Charles T. Jackson (who visited the locality as early as 1869) and with the above-quoted views of Dr. T. Sterry Hunt:

Dr. Shepherd stated: "A notable fact, not only of individual, but also of national importance, is the opening of five or six metallic veins of rich tin ore in the township of Winslow, Kennebec County. State of Maine * * * * After uncovering the first vein some time since, * * * I was called to make a geological report of the same. I accordingly visited the locality and was deeply interested to find a true, definite vein, of one foot or more in thickness, composed of quartz, rose colored mica, or lepidolite, purple fluor-spar, carbonate of iron, tourmaline, with occasional crystals of calc spar, together with arsenical pyrites. In the midst of these, the rich dark tin ore was found imbedded and surely I could not have wished for more favorable indications. The rock formation enclosing this vein was found composed of grauwacke and to some extent calcareous slates, or what is called Killas in Cornwall, * * * In addition to the above favorable indications, a strong elvan wall, or dyke, of apparently gray trap, accompanies the above vein and its companion veins, giving great promise of strength, depth and continuance, as have been found by similar elvan guides or leaders in the rich mining districts of Cornwall * * * Here in Winslow we have tin ore at the surface, in quality equal to the best in Cornwall and in a series of veins most favorably situated; while in Cornwall, in some mines it is found necessary or as a matter of economy, to have a blacksmith's shop one thousand feet under ground, so as to sharpen the tools used five hundred feet below * * * Shall the United States longer depend on foreign nations for their tin? Shall they reap foreign fields when they have an abundant harvest at arm's length? In what part of the world will they find a supply of this valuable metal at greater advantage than on the banks of

the beautiful Kennebec. * * * In a course of careful surface exploration from Tav'stock in Devonshire, all the way through Cornwall to Land's End, in no place could I find indications more promising for successful tin mining than here at Winslow."

Dr. C. H. Hitchcock, another predecessor of mine as State Geologist of Maine, in 1880 reported that "thirty feet width of vertical sheets of killas, show twelve granite veins from half of one inch to three inches in width, crossed, occasionally by stragglers. These veins are full of crystals of tin ore (cassiterite) with the associated minerals, fluor-spar, margarite, mispickel, beryl, lepidolite, etc. This mode of occurrence recalls to mind the tin floors and stockworks of Cornwall and Germany. The mineral, geological and physical features of this mine at Winslow are identical with those common to the stanniferous districts of Europe. If Winslow was in Cornwall, this property would be explored at once. Hence we are authorized to recommend the development of these tin floors in Maine.

"The ore seems to be sufficiently abundant to remunerate quite extensive outlays for mining operations."

So much for the testimony of others.

For myself, I can only say that after careful geological reconnaissance of this locality, I regard it as the one promising outlook for the development of a tin mine in the United States. And with that convicton, which may be born of stubbornness and may result in disappointment, I have been gathering up ownership interests along the line of this mineralization until I have acquired control of a sufficient area to demonstrate the correctness or incorrectness of my views, and am in position to go ahead at my convenience and as means may allow on its development.

Statistics compiled by the National City Bank of New York in 1918, showed that the United States is now turning out over $100,000,000 worth of tin plate annually and that for all of this and the other industries using tin, the United States is dependent upon mines on the opposite side of the globe, though considerable quantities are now drawn from Bolivia, which now produces nearly one third of the tin of the world. "All efforts" said this great bank, "successfully to develop tin production in the United States which now uses about one half of all the tin mined in the world, have thus far been unsuccessful." The quantity of tin imported into the United States has grown from 35,000,000 pounds in 1890 to approximately 140,000,000 pounds in 1917.

The value of the tin imported into the country since the beginning of the tin plate industry in 1893 has aggregated approximately $700,000,000, according to this circular of the National City Bank, about 90 per cent of it being used in the manufacture of tin plate of which the production in the United States grew from 42,000,000 pounds in 1892 to 2,766,401,227 pounds in 1917. With this large growth in our domestic manufacture of tin plate has come what the bank's statistician regards as an even more startling growth in our exportation of that article.

The value of our exports of domestic tin plate amounted in the fiscal year 1898 to less than one thousand dollars; in 1908, it had reached $1,300,000 and, in 1918, it attained the colossal figure of over $50,000,000. Of this large exportation in 1918, according to the bank's circular, about $8,000,000 worth went to Argentina; $8,000,000 worth to Japan, $5,-000,000 worth to Italy, $6,000,000 worth to Canada and approximately $2,000,000 worth to the Straits Settlements and the Dutch East Indies, the two latter being the very sources from which we drew most of the metallic tin used in the manufacture of this enormous production of tin plate. Remembering that prior to the passage of the McKinley tariff act, there had never been any tin-plate manufactured in America, tin-plate production having been for centuries a monopoly of Wales, and that ever since there has been and now is no tin mined in the continental boundaries of the United States, this exportation from our country of tin plate to the tin producing regions of the Malayan and Dutch East Indies is truly characterized in the bank's illuminating circular as startling.

The appeal to patriotism involved in the effort to create a domestic production of tin is most impelling. And the apparent opportunity to create such a production at Winslow is inviting. Let it not be thought that I minimize or underestimate the difficulties of the undertaking. The location and adequate development of virgin, underground minable ore bodies is a slow, laborious, heart-breaking, purse-straining brain-wearying struggle against the forces of Nature, as I have been taught by practical experience in the gold-fields of Alaska and Nova Scotia, the copper producing districts of Maine and Montana, as an individual mine owner, and operator, and as a stockholder in some of the world's largest mining corporations. But it is a man's sized job and the rewards of success therein are commensurate to the risk and labors incident thereto.

In gathering up the broken threads of precedent effort at Winslow and in making future efforts there to locate and work minable ore bodies of tin, I feel myself actuated as largely by public interest and desire to serve my State and nation as by the incentive of private gain. If I can duplicate at Winslow the results attained in the development of my molybdenite ore body at Catharine Hill where the reports of highly qualified engineers show that I have blocked out more than ten million tons of millable ore. I shall feel that I have done something for Maine, the State of my residence, the metalliferous resources of which are vast, though largely unrecognized by her people. With the inevitable exhaustion of her timber reserves, it will be necessary for the State more and more to develop its great dowry of mineral resources.

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Bird Stories, by Edith M. Patch with illustrations by Robert J. Simm, the second volume of "Little Gateways to Science," published by the Atlantic Monthly Press of Boston, is at hand and fully up in quality and absorbing interest for young people to Miss Patch's Hexapod Stories. This is just the book for Junior Audubon societies and for use by nature teachers in our schools.

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All the Naturalists and Nature lovers of the State should assist in making this a live, interesting journal by sending in notes and longer articles to the several department editors. You must not expect these hard-worked editors to do all the writing.

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# ANCIENT SHORE LINES AND EARTH MOVEMENTS IN MAINE

By Edward H. Perkins

One effect of geological study is to remove many of the popular ideas in regard to our earth. One of the most strongly held of these ideas is that the earth, outside of a few earthquake regions, is firm and unchangeable. Geologists have shown us, however, that our terra firma is in more or less constant movement, now rising, now sinking, as compared to sea level. The object of this paper is to consider some of the evidence on which the geologist bases his theories of earth movement or diastrophism. It happens that in our State we have many of the lines of evidence well displayed.

As we look at our sea coast today, the thing that impresses us is its extreme irregularity. Deep bays indent the shore line and many islands rise to greater or less heights above the sea. The deep bays gradually pass into larger river valleys, while on the seaward side soundings show the continuation of the valley depression far out to sea. Most of the islands appear to be continuations of the hills and ridges of the main land. These features are well shown in the new topographic map of the U. S. Geological Survey. In these maps the configuration of the sea bottom is shown by contour lines in the same manner as the land surfaces. A study of these maps clearly shows that we have either a rising of the sea or a sinking of the land. The valleys are flooded by the ocean and the ridges are covered save for the higher portions which now appear as islands.

This shore line is a thing of today. For a record of the past we must look for old shore lines and their characteristic features. These old stands of the sea are indicated by two lines of evidence; erosion or the distructive work of water, and deposition or the constructive work.

The erosive work of the sea is due to wave action and is limited to a zone between the wave base beneath the surface and the point on the coast reached by the highest storm waves. Within this limited area the sea is tearing into the land. Behind it leaves a gently sloping cliff or wave cut terrace marking the lower limit of wave action. Landward the advancing notch undermines the shore until the rock gives way and falls in fragments to the shelf below. These boulders are seized by the waves as tools for its work and hurled by the waves against the shore until they are ground to sand and carried out to quiet water. If the land should

now be lifted the old sea level would be indicated by the undermined sea cliff with the flat terrace in front. These wave cut notches are not uncommon along the Maine coast where ever resistant rocks face the sea. Sometimes they occur one above the other like a series of giant stairs; the record of each pause in the retreat of the ocean. On Mount Desert Island these levels extend from 20 feet above the present sea level to near to the mountain tops at 1500 feet.

Rocks vary greatly in their resistance to wave attack. Sometimes the character of the rock itself enables it to withstand the buffets of the sea. Again the bedding plains or joint structure may cause rapid erosion in some places and slow erosion in others. This difference in the rate of erosion induces irregularities in the typical form of the sea cliff and terrace. Isolated masses of rock are sometimes left standing on the terrace. These may reach the size of an island like Boneventure and Perce Rock on the Gauspe' coast. More often they are small rock stacks which will soon yield under continued attacks of the sea, unless preserved by uplift. On the seaward side of Day Mountain on Mount Desert Island are several well developed rock stacks identical with those forming today on the shore several hundred feet below.

Along our Maine coast our granites are often cut by dikes of basalt. This latter rock is less resistant than the surrounding granite and so yields to erosion. A chasm or purgatory is formed often scores of feet in depth with walls of solid granite. The surging of the waves in and out of the chasm give rise to the phenomena known as sprouting horns, blow holes and thunder caves. Lifted above sea level these chasms furnish another index of elevation.

The last episode in our geological history was the retreat of the great ice-sheet. This left the rock surface of our state covered with debris from the melting ice. Within reach of the waves this cover was soon washed off leaving bare rock. The upper limit of this washed surface shows the highest sea level since the glacial period.

The sea is not only destructive but also does a certain amount of constructive work. The fragments from the destruction of the land are worked over by the waves and currents. The larger pieces are left as pebbles near the shore line, the finer sand is carried farther out where motion is less, while the finest material or clay is deposited in quiet water. If these marine deposits are now found on land

they indicate not only the former elevation of the sea, but give us some clue as to the depth and movement of water at that place.

All over the southern and eastern portions of the state and well up the river valleys we have thick deposits of marine clays. In places these are rich in fossils. Many of the forms are living today in northern waters. They point to a time when the water of the Maine coast was as cool as that of Labrador today. A few fossil leaves have been found which indicate a land temperature not far different from that of today. At the time the clays were deposited the sea stood at least 200 feet above its present level and received torrents of ice-water from the glaciers still lingering in the northern part of the state. Over the clays we have in some places beds of marine sand. Often these show dune structure indicating old beaches where the wind blew the sand into dunes like those on Cape Cod today.

Where ever a stream enters quiet water its velocity is checked and the sediment it carries is deposited. This material collects until a delta is formed which may, as in the case of the Nile or the Mississippi, reach great size. Each stream flowing into the bays which indent our sea coast is building its delta at the bay-head. At a time when the land was lower and the sea extended far inland similar deltas were formed and their eroded remnants indicate the former bay-head. For example, there is a delta in the Saco Valley at Bartlet, N. H., 705 feet above sea level and one on the Androscoggin at Bethel 720 feet in elevation.

Not only did the present streams form deltas, but streams long since gone have left their records in deltas and other deposits. Toward the end of the glacial period a stream flowed south from the vicinity of Hartland through Pittsfield, Burnham and Unity, and finally formed a delta at its mouth in Montville. Today the delta stands out on the hillside indicating an old shore line at about 700 feet. As the sea receded new deltas were built by the main and tributary streams along each valley. Each series of deltas marks a halt in the retreat of the sea. Such low-level deposits are found in the Androscoggin at Lewiston, in the Kennebec at Skowhegan, in the Saco at Buxton at altitudes ranging from 525 to 575 feet showing a stand of the sea at about that level. There are other deposits at higher or lower levels.

Another line of evidence which has been developed lately is found in the peat deposits of the coast. Peat is formed by the decomposition of vegetable matter beneath a water cover. As salt water and fresh water peat each has its character-

istic plants, a study of the plant remains of any deposit will give us an idea of its history. A study of the peat bogs of our north Atlantic coast shows in several cases a layer of fresh water peat beneath the salt water peat now forming on the surface. This shows that the bays once stood above sea level and were filled with fresh water. Subsidence set in and the bays became salt. The fresh water plants were replaced by salt water species and the present surface layer of peat was started.

The above features are all evidences of relatively recent movements of the shore line. The clays, deltas and peat beds are all unconsolidated and subject to rapid erosion when elevated. Although only a short time has elapsed since the retreat of the water, these deposits are already cut up and partially removed by stream action. Even the sea cliffs and terraces last comparatively only a little longer. Frost action of the exposed rock will soon destroy the features of wave erosion. For a study of the more ancient sea levels, those which preceded the glacial period, we must turn to another type of evidence. This is to be found in a study of the summit levels of the inland hills and mountains.

The striking feature of the landscape of the greater part of New England is the almost level skyline. Although the country is carved into hills and valleys, the hills rise to practically the same level. Often they contain areas of level land on their summits. This accordance of summit level is independent of rock composition and structure. The cause must be sought in some factor outside the rocks themselves. The explanation given was that the level hill tops were the remains of a great plain which once covered most of New England. Here and there isolated mountains rose from this plain with one larger group, the higher peaks of the White Mountains. This plain was formed by river erosion. After this level surface was well developed it was lifted and tilted. The revived rivers at once started to carve the surface until it reached its present condition. During this time, the Cenozoic Era, several plains were developed, tilted and buried in the coastal region from New Jersey south.

In 1912 the late Professor Joseph Barrell read a paper before the Geological Society of America in which he pointed out that the great plain of New England was not a single plain, but a series of great steps with treads miles broad and rises of a hundred or so feet. The hill tops are accordant and form a level sky-line for several miles, then there is a sudden increase in elevation of the hills with the tops ac-

cordant at the new level. This is normal sea cliff and terrace feature enlarged to a gigantic scale. According to Professor Barrell the sea would stand at a certain level long enough to erode the coast miles inland. This was followed by rapid retreat to a lower level where the process was repeated. This stand was not long enough for the complete destruction of the terrace above. Thus, by progressively rapid retreat New England was carved into a series of steps. As soon as a wave swept level was exposed to subaerial action river and atmosphere erosion carved it into hills whose tops still show traces of the old terrace level.

Barrell in Connecticut has recognized eight of these wave cut terraces ranging in height from 500 feet to 2300 feet. He correlates these terraces with the erosion levels of the coastal plain to the south. The terraces pass north and north east but have not been studied north of the northern boundary of Massachusetts. An extension of these shore lines would pass into central and western Maine. A great part of the state is still unmapped on the scale necessary for the accurate determination of the wave cut benches. In the southeastern part of the state there seem to be accordant hill tops at 300, 400, 700, 1100 and 1300 feet above sea level. More careful work is needed to determine these levels with exactness.

We have now considered some of the evidence whereby geologists have come to the belief that the Earth's crust underlying New England has been unstable. In closing we will briefly outline the geological history of Maine during Cenozoic time as indicated by the wavecarved record.

The beginning of the Eocene, the first period of the Cenozoic Era, saw the greater part of Maine beneath the sea. Probably the shore line was in the western part of the state or even in New Hampshire. Here and there islands or groups of islands rose above the waves. These were the tops of the present mountains. In general appearance the coast was not much different from that of today. The whole of North America was unstable. In the extreme west the mountain making movements which ended in the Cascadian Revolution had already started. In the east this unrest showed in the gradual uplift of New England. The movements were rythmic, a time of relative quiet being followed by a period of rapid uplift. During the periods of quiet the sea ate its way inland forming a nearly level sea floor from which masses of resistant rock rose as islands. Then, with renewed movement of the earth the sea would retreat until a new period of quiescence allowed a new ad-

vance over the land. The seabottom exposed to the atmosphere and water was attacked by these agents and gradually carved into the present topography. Just how far the sea retreated and just how high the land stood at the beginning of the glacial period we do not know. The fact that the hills and valleys of the mainland extend eastward under the sea seems to indicate that the shore line was to the east under what is now the Atlantic ocean.

A new factor now appeared and played a decided part in the movements of the crust of New England. Toward the end of the Pliocene Period and in the Pleistocene period the climate of northeastern North America became so cool that the winter snow fall did not entirely melt the following summer. Glaciers developed in the highlands to the north of St. Lawrence and slowly moved southward until they reached the ocean south of what is now Long Island. The weight of this immense ice sheet seems to have depressed the earth's crust, considerably, under the interior of the ice sheet; slightly near the margin where the ice was thin. At the same time the surface of the ocean was lowered as water was removed and locked up in the great glaciers as ice.

With the return of a warm climate the glacier melted, slow at first, more rapidly as time went on. As the glacier retreated the ocean waters followed, lapping the ice front as it receded. This advance of the sea was in part due to the low stand of the land not yet recovered from the depressive weight of the ice and in part to the return of water to the ocean from the melting ice. At its greatest extent the ocean waters covered all the parts of New England below the present 700 or 500 foot contour. The portion above water was an island as the sea extended up the Hudson Valley and met the waters of the Gulf of St. Lawrence in the region of Lake Champlain. It was at this time that the high level deltas were built in our valleys.

The earth, however, is an elastic body and it soon began to recover from the depression due to the weight of the ice. The new upward movement started in the south and increased to the northward as the ice retreated. Like the depression, the uplift was greatest where the ice had been thickest. The record of this differential movement is recorded in tilted shore lines. These must have been formed by a horizontal water surface. Now, however, one end of a strand line may be scores of feet higher than the other. This upward movement in Maine seems to range from 200 feet near the coast to about 800 feet on the Northwestern border.

Whether this upward movement is still in progress we cannot tell. Rapid as they are compared to the immensity of Geological time, they are infinitely slow in terms of human history. New England may not yet have entirely recovered from the crushing weight of the great glacier. On the other hand it is possible that the rebound of the earth carried us too far upward and we may now be settling back to equilibrium. The fact that our peat bogs show fresh water vegetation beneath salt water deposits indicates a local settling at least. There is also the fact that we find southern plants in such places as Cape Ann, Nova Scotia and Newfoundland. To account for these isolated colonies some botanists have held that since the Glacial period the land has stood higher than it does today. This would leave a coastal plain extending from New Jersey to Newfoundland. The southern plants worked north along this plain at least as far as Newfoundland. Since then a sinking of the land has drowned the plain and only a few isolated colonies of southern flora are left in the north. However, there is no geological evidence for such an elevation and sinking of the land since the end of the glacial period.

The above gives briefly the main features of our more recent geological history. Much of it appears vague and indistinct through the mists of the past. A great deal of work remains to be done and many problems solved before the history is known in its entirety. We do know that the present is but a scene in a drama which extends back with a remote past and forward into an equally remote future.

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DEVIL'S DEN NEAR CASCO


A MINERAL LEDGE NEAR CASCO

# MINERALS AND ROCKS OF CASCO, MAINE

By Celia M. Compton

The mineral sections of Maine left undeveloped, especially the glacial and pigmatite section which has been estimated as seventy miles long and forty miles wide, make one feel a great responsibility, and as Casco is the center or heart of it, one of these days, in the not far future, you will hear something of its minerals and rocks and have many more interested in its development.

When I began my geological explorations and work, I was obliged to go slow as I had not a single sympathiser in the town. I soon found, within a radius of ten miles of Casco Village, indications of mineral deposits and was thus spurred on to renewed efforts. At White Oak Hill in Poland I found white quartz that tested a small per cent of silver, but the ledges were too small to pay for working. The Summit Spring House is made from the surface rock of one of these ledges.

One morning three ladies started out to follow a trap-dyke. We traced it from the Summit House grounds, across the road, through the woods, across a field, through a pasture and into another piece of woods, where we were obliged to tie pieces of red bandanna on the branches of trees, as a guide in retracing our steps. We finally came to the "jumping-off place," where we found a ledge of high grade feldspar and dug what some called "the wood-chuck's hole." This was several years ago. Later mining was begun with very satisfactory results, but the death of the owner resulted in the working being abandoned. I am hoping that its development will be renewed and my statement or prediction—that the depth will bring forth a fine quality of feldspar and crystals of value and its length will connect with a vein that will extend for a long distance—will be proven true.

Not far from this dyke I found a jasper ball, which, when broken open with a sledge-hammer, disclosed to view a pocket of jasper crystals. A beryl of rich lilac hue was also found near here.

On one occasion noticing a little lame chicken picking up pretty stones, I decided to investigate the case more thoroughly, so after her demise I found the gizzard contained some very fine blue beryls or acquamarines. These had been ground into unique shapes by the rubbing of the

stones against each other. The color was like the color of those Mrs. Roosevelt had cut to match her Alice blue dress, which she wore at the Inaugural Ball.

The forms that minerals take in crystalizing are interesting because of the statement that all geometrical figures were taken from them. Thus muscovite gives us the square, the diamond shape, the triangle, the parallelogram, the hexagon, the heptagon and even the octagon. I have a seven-sided figure with shining mica for the center and a perfect rim or frame of the blue lithia mica. The circular mica is interesting because of the sockets left after taking pieces out.

Not far from the Hotel we found large iron garnets inbedded in a very hard granite. The granites of this locality are of five different colors, some suitable for monumental work, taking a fine polish.

In West Poland, where a well had recently been dug, I found brown tourmalines. There was every evidence that a pocket had been found and the crystals either thrown back into the well or carried away. The soft, black tourmalines are very abundant on White Oak Hill and in Casco; the hard crystals being found in only one place as yet. In West Poland I found some yellow ochre of very good quality and painted a little box with it, simply mixing the pounded clayey stone with oil.

An iron mine at Webb's Mills tests a high per cent of iron and will be profitable when transportation facilities can be provided. At the present time distance to the nearest railroad station takes off all profit. Sulphur of a very fine grade occurs here, the richest deposit, unfortunately, lying under a building.

Within a radius of three miles of Casco Village I have found a variety of minerals; iron pyrites in large-sized cubes, muscovite or mica of such quality and size that I put a piece in my stove for a window and after using it for a year it still remains hard and clear, rose quartz, bright green pyroxine with brownish-red garnets (this is one of the prettiest specimens yet found,) and calcite with a very brilliant cleavage.

On the beach of Pleasant Pond the sand was so highly colored red one morning that we thought something unusual had happened, but upon closer inspection we found that the sand was filled with pretty little garnets. When we went back a few days later for samples to be used in filling souvenir bottles, the garnets had all disappeared, having been washed back into deeper water.

The ledges of feldspar are numerous and one of them has a cave large enough for a person to move around in comfortably. It is within a short distance of Casco Village. About two miles from this one there is another cave, which, as far as I can learn, no woman has ever entered until recently. It has a narrow opening and a very steep ascent. After entering I found a nice little room lined with pink feldspar. Light came in through two small apertures. The interior is at least ten feet long, four feet wide and from three to five feet high. I could easily stand upright in one place. The opening to the cave is concealed from casual view by trees and bushes. Near here is the Devil's Stairway and the Devil's Fire-place, the cave itself being called "The Devils Den." There is another cave by the same name near Webb's Mills. I know a place where white quartz crystals are hanging in clusters, but the owner as yet has been too stubborn to be approached.

The bill drawn up a few years ago in regard to forcing the opening of mines and giving the discoverer a certain percent, should be put into effect.

I will sum up my "finds" in Casco, and within a radius of ten miles, as follows: Iron pyrites, blue beryls, lavender beryls, rose quartz, silver, pearls, brown, black, and dark brown tourmalines, cinnamon garnets, iron cubes, ironore, inferior garnets, jasper crystals, white quartz crystals, pink feldspar, white clevelandite, muscovite, sulphur, yellow ochre and several kinds of granite.

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## Notes for Geological Section

It is purposed to publish in the Maine Naturalist a list of the minerals found in Maine giving the more important occurrences of each species. It is desired to make this list as complete as possible. Any person who has a local list of minerals is requested to send a copy to the editor of this department. Edward H. Perkins, Box 52, Waterville, Maine.

## SCIENTIFIC ASPECTS OF MT. DESERT ISLAND

Barrington Moore, Editor of Ecology

Mount Desert Island exhibits features which are of unusual significance to the student of natural history.

The island is what is known to scientists as a tension point or meeting point between different plant and animal habitats. Such places have a peculiar fascination for the scientist in that they afford unusual opportunities for studying, among other things, the relation of plants and animals to their environment, matters of much practical importance in farming, in forestry, in horticulture and many other pursuits. Here it is primarily a meeting of north and south, in which the north seems to be the present master, but the south strongly represented.

From the forestry point of view I can state that on no area of this size have I seen growing together forests representing such different conditions and consequently with such different requirements. Our knowledge of the requirements of different forests for soil, moisture, climate, etc. is very inadequate, and the diversity which we have on Mt. Desert island offers unusual opportunity for adding to this all important knowledge.

The forests of spruce and fir such as grow on Otter Cliffs, along a large part of the southern shore of the island, in the Gorge between Dry and Cadillac Mts. and on many other parts of the island are truly northern, like the forests of Canada, of the northern part of this state, and of the Adirondacks above 2500 feet elevation.

The white pine forests of central New England are represented at Faun Pond, on Bear Brook Hill along the main road just south of Bar Harbor and at several other places.

And yet we find also on Kebo Mountain along the shore drive and elsewhere, forests of pitch pine similar to those growing in New Jersey and Long Island. The forests of Mt. Desert Island, therefore, represent a stretch of country extending from Labrador to southern New Jersey.

The vegetation in general appears to be even more remarkable than the forests. Rand has found on the island 230 species of plants common to the arctic. The crow-berry, Empetrum nigrum, grows here at sea level, while inland at this altitude and even farther north it is found only on the summits of the high mountains above timber line under truly arctic alpine conditions. And still the southern sweet fern grows here in actual contact with these boreal plants.

An indication of the comparative mildness of the Mt. Desert climate, in spite of its arctic flora, is to be found in a group of Japanese pines growing at one of the gateways north of the village of Bar Harbor, a tree so sensitive to cold that it is killed at the latitude of New York, which yet has lived on this island for twenty years without protection in winter.

It appears that the same interesting distributional relationships are found among the insects of the island. Dr. C. W. Johnson of Boston collected in Witch Hole Pond a certain insect which had hitherto been recorded only from extreme northern Europe and Alaska; and yet he has found many southern forms. He has also discovered on the island a number of species hitherto unknown to science.

Scientists all over America are urging the preservation of natural areas for scientific study. In research on distribution, on the influence of environment upon plants and animals, and on adaptation, it is essential to have areas on which the flora and fauna can be found undisturbed by outside agencies. The creation of the Lafayette National park on an island of such great interest as Mount Desert Island is, therefore, of the utmost importance to science.

Little is known for sure yet of the causes of this important distribution.

These causes are not only interesting in themselves, but should help solve ecological problems.

Many of the factors to be considered:

1. Northward migration after retreat of glaciers. Land connection with coastal plain to account for pitch pine and C. P. species.

2. Coolness of Arctic current probably a factor in Arctic species along shore.

3. Uniformity of ocean climate for parts of island in preventing extreme changes.

4. Variety of habitats due to mountains. Exposure and shelter, moisture and dryness; intense isolation vs. mountain shadows; steep vs. gentle slopes; bare rock vs. soil.

5. Result must be different climate in different places. Different temperature, moisture, light and evaporation.

6. Soil. Certain amount of variety. Mostly glacial and decomposed granite. Mostly rather sandy and gravelly, but some heavy clays, notably a blue marl. Most soils slightly acid, but some neutral. Surface humus of forest strongly acid.

## DEPARTMENT OF NATURE STUDY

Editor } Prof. William L. Powers, Machias

### THREE BIRD-FLOWERS

By John H. Lovell

The most common bird-flower in Maine is the cardinal flower (Lobelia cardinalis.) It favors the banks of running brooks and streams, where its scarlet--red flowers, over an inch in length, glow like small tongues of flame, for no more vivid red flower is to be found in the North America flora. From time to time there flashes from flower to flower the ruby-throated humming-bird, itself agleam with color. Bumblebees cannot reach the nectar at the bottom of the long corolla-tube, but they sometimes steal it through crevices in the base of the blossoms.

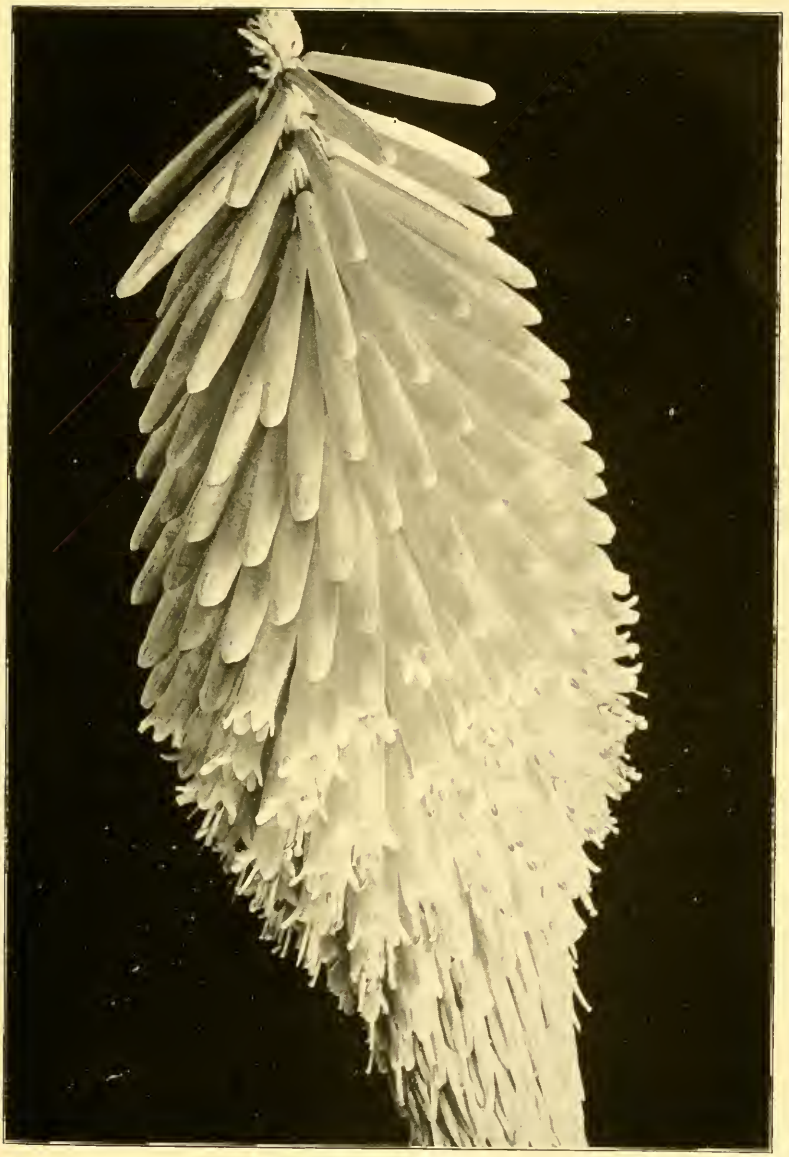
There is another species of lobelia, the great lobelia (L. syphilitica,) which has blue flowers with a corolla-tube only half an inch long. It is pollinated by bumblebees and the hummingbirds pass it by unheeded. When these two plants grow side by side, it is interesting to notice how the humming-birds are constant to the scarlet flowers and the bumblebees to the blue blossoms. In South America and Africa there are several other species of lobelia which are bird-flowers.

Another well--known bird-flower is the trumpet honeysuckle (Lonicera sempervirens,) which grows wild southward, but is frequently cultivated in Maine gardens. The corolla-tube, which is two inches long, is crimson outside but yellow within. The nectar lies far beyond the reach of bees, but is readily obtained by humming-birds. It is a climbing shrub with scentless, trumpet-shaped flowers in whorls.

Last summer I saw in a Maine garden a large bed of the red-hot poker plant, or torch lily, in full bloom. The big

CARDINAL FLOWER
(Lobelia Cardinalis)

TRUMPET HONEYSUCKLE (Lonicera sempervirens)



TORCH LILY OR RED-HOT POKER PLANT
(Kniphofia aloides)

racemes of coral-red flowers, turning orange with age, always excite admiration and wonder. The plant comes from the Cape of Good Hope, where it is pollinated by sun-birds. The long scape, or flower-stalk, rises from a clump of grass-like leaves, three or four feet in length, and there is a long succession of flowers during the summer.

In New Zealand a native beekeeper says that the nectar can be plentifully shaken out of the tubular flowers, and that it is then eagerly gathered by bees. Sometimes they creep into the narrow tubes and become wedged between their walls, and die miserably of starvation in full view of the sweet spoil.

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"I received the copy of 'The Maine Naturalist' you so kindly sent me. I can assure you I have read it with the greatest of interest and must say what a glorious journal for the people of Maine. If they get one half the pleasure out of it that I have they should feel exceedingly proud at having such people in their midst that can hand out such valuable and interesting information. I cannot comment on any particular article as they are all so very interesting. I almost felt sorry when I arrived at the end and shall certainly read it again. I have lent it to my dear old friend Mr. Matthews whom I am sure will read it with the greatest of pleasure."—C. Walton, Peterhead, South Australia.

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By viewing Nature, Nature's handmaid art, makes mighty things from small beginnings grow: Thus fishes first to shipping did impart, their tail the rudder, and their head the prow. —Dryden.

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# THE STATE FIELD MEETING

The first State Field Meeting of the Knox Academy of Arts and Sciences was held the 23d and 26 th of August inclusive. The four days of lectures, trips, outings and study covered literally the whole of Knox county and were attended with the most conspicuous success. The long list of well-known Naturalists and Scientists registered and the state-wide press comment only goes to prove that the young Academy has come to make itself felt in the future of the State.

Members of the Academy came in autos from Portland, Lewiston, Auburn, Skowhegan, Saco, Augusta, Hallowell, and Belfast, while others came by train from Casco, Farmington, Phippsburg, and other towns. About 100 members and friends attended the first day's session, which was held at the Knox Arboretum.

In opening the meeting, President C. Vey Holman called upon First Vice President Rev. C. W. Turner of Bar Harbor, to invoke the Divine blessing upon the meeting and the work of the Academy. Following the prayer, couched in language of appealing devotion, President Holman delivered a graceful and eloquent address of welcome, pitched to a high key of patriotism, voicing the Academy's mission as not merely the advocate of technical and scientific culture among the people of Maine but as an institute of civics, inculcating doctrines of true Americanism, based upon consecration to the ideals of constitutional government and true liberty regulated by law. Moral and Spiritual advancement along lines of universal service he pronounced to be as much the business of the Academy as the inculcation of the love of nature and science. In response to the president's address, Mrs. Sarah Rideout Abbott of Saco spoke charmingly and eloquently along lines of similarly lofty idealism.

After partaking of a picnic lunch, served by the local members, the assembled members and visitors listened to a very interesting talk by Mrs. Charles W. Alexander, President of the Ball Bird Club of Augusta, on "Maine as a Bird Lover's Paradise."

Mrs. Alexander was followed by Mrs. Winnie Harward Phillips of Washington, D. C., who talked on "Insect Eating Animals of North America," giving many instructive facts regarding toads, lizards and mice.

Mrs. Sarah Rideout Abbott who upon her arrival had taken a short walk in the Arboretum and gathered some 40 species of mushrooms, now gave a most fascinating talk on these and other Maine species, telling how to distinguish the poisonous from the edible.

After Mrs. Abbott Dr. George P. Merrill of the National Museum at Washington, spoke briefly on the geological formations of Maine and its "drowned" river systems and gave some very interesting personal reminiscences.

Miss Celia M. Compton next read her paper on the "Minerals and Rocks of Casco."

State Forester Samuel T. Dana gave a most interesting and instructive talk on "Maine's Forests and their Future."

At the close of his remarks the meeting adopted by a unanimous vote the following resolution offered by Major Barrington Moore of New York City:

WHEREAS, the conservation and wise utilization of our forest resources is essential to the welfare of this and other New England States; and WHEREAS, the Development of sound forest practice is dependent on scientific investigation; and

WHEREAS, There is now pending in Congress a bill for the establishment of a New England Forest Experiment Station; be it

RESOLVED, that this Academy earnestly favors the passage of this bill, and urges the representatives of the New England States now in Congress to do everything in their power to secure the establishment of such a station.

Major Moore is the editor of "Ecology," a scientific magazine, and a contributing member of the Knox Academy.

The Rev. C. W. Turner spoke briefly on the work and purpose of the Academy, and made an appeal for the interest of the people in their important work. Rev. Henry Dunnack, the State Librarian of Augusta, then gave a talk which was brilliant in every detail. He claimed modestly that he knew nothing, and for that reason he could talk as glibly on any subject as if he knew all about it, while the Scientists knew so much about their one subject, that they only succeeded in learning how little they knew. He ended in a eulogy of Science, and a statement to the Scientists that they were the people of the hour, on whom the whole world must to a great extent depend. Mr. Dunnack inspired a feeling of the utmost goodfellowship among those present, and his remarks were received with a goodly meed of applause.

C. Vey Holman with a talk on "Tin and Other Rare Minerals of Maine," opened his hearers eyes to the fact that

there were undoubtedly very favorable prospects of discovering tin deposits in our state.

Circulars were distributed among the guests of the Academy, containing an "S. O. S. Call" for aid in preventing the dreaded white pine blister rust. Lists were also given of the trees and shrubs in the Arboretum, of which there are over 124 different varieties of the former and 110 of the latter.

## Evening Session

At the evening session which was held in the Congregational Church at Thomaston, a paper was read by Miss Carrie Ella Miller of the Stanton Bird Club on "The Birds of Lewiston and Auburn, Me." A paper on Forestry Conservation and modern methods of reforestation was read by Prof. Bernard E. Leete of Bates College. Prof. Edward H. Perkins of Colby College gave a very interesting talk on the changes of our coast line that have taken place during past centuries. Prof. Barrington Moore of New York gave a brief talk on the plant and animal life found on Mt. Desert Island, in relation to their environments.

Mrs. Abbott of Saco, was then asked to give another talk on Mushrooms which was very interesting and instructive. The Camp Fire girls gathered some more Mushrooms before leaving the Arboretum, and were fortunate in securing 10 species that were not on hand for the afternoon lecture, making a total of 55 different species of mushrooms found in the Arboretum on that day.

The meeting was brought to a close after a brief message from Mr. Lermond, Curator and Librarian of the Academy.

The second day was given over to an excursion by steamer to Monhegan and to Islesboro. Thirteen went to Monhegan, one of the grandest spots on the coast of Maine. They were received there by one of the Gardiner members of the Academy, Mr. Bertrand H. Wentworth, who conducted the party over the wild and beautiful little island. Several went to Islesboro and a few remained to examine at leisure Mr. Lermond's remarkable collections, the nucleus of the new Museum. This collection will be fully described in a later article. The Rockland Courier-Gazette of August 27 gives the evening program: In the evening an illustrated lecture was given in the Baptist church at Rockland, by Prof. John M. Briscoe of the University of Maine on "The White Pine Blister Rust." Prof. Briscoe has made an extensive study of this disease and is at present conducting crews of men employed in the eradication, and is therefore able to speak

on the subject from a very authoritative standpoint. His very instructive and interesting talk was much enjoyed. There were also short talks by Prof. Bernard E. Leete of Bates College, on "Forestry," and Prof. Edward H. Perkins of Colby College, who spoke on "The Ice Sheets and Glaciers that Once Covered the State of Maine."

Wednesday, August 25, was spent in automobile excursions to the Camden Mountains and over the famous Turnpike Drive, which encircles beautiful Lake Megunticook. Some doughty scientists climbed Mt. Battie via bridle path and were met an hour and a half later at the foot of the carriage road. The rest of the party were entertained by Miss Mary Palmer at her cottage on the lake-shore. Miss Palmer added delicious coffee and ice cream to the picnic lunch which had been brought. In the afternoon several climbed Megunticook Mountain at the Maiden's Cliff for the marvelous view, as well as for botanizing. It might not be amiss to state here that according to the "oldest inhabitants" the young lady who lost her life at this sad point was not a victim of unrequited love, neither was she chased by an Indian. She simply reached too far in her zest for a certain charming flower she coveted, perhaps one of the delicate hairbells found on this particular day.

The Knox Messenger of September 1, says: The evening was spent in the Congregational church at Thomaston, where a lecture and several very interesting talks were heard. Mrs. Phillips of Washington, D. C., who is recognized as an authority on "Insect Eating Animals of North America," gave a very interesting talk, and Prof. Perkins, and Miss Compton also gave short talks on Ornithology.

At this evening session Prof. Alfred O. Gross gave his lecture on the Junior Audubon clubs of Brunswick, illustrated with some 200 beautiful colored slides, from photographs made by himself and the "Juniors." The slides illustrating his intensive study of the Black-capped night Heron and Night Hawk were certainly remarkable, to say the least.

Sixteen members took advantage of Friday's excursions. The Courier Gazette of August 30 gives the following: The members of the Knox Academy of Arts and Sciences concluded their visit to Rockland and vicinity on Friday with an auto trip to the quarries and Capt. Willis Snow's farm at Dodge's Mountain, thence via Rockville and West Rockport to Sherman's Point in Camden where a picnic lunch was served, and a period devoted to bird study and botanizing, when the happy party separated with many regrets at parting and congratulations on the amount of good accomplished.

There was a universal expression of appreciation of the liberality of the committee of transportation in providing autos, and of the street commissioner Mr. Ross, in placing the Dodge farm road in so excellent condition.

Never before have so many men and women, able and accomplished in so many branches of scientific study, been brought together here. The lectures, given by professors of the various Maine colleges, eminent specialists from Washington, D. C., and other special experts who seldom appear in public were most brilliant and up-to-date, and were given "without money and without price." By next year, when the Academy hopes to have a fireproof building in which its priceless collections can be properly protected and displayed, Knox county will be a mecca for the scientists of the country.

At this first State Field Meeting of the Knox Academy, the following nature clubs and societies were represented: The Ball Bird Club of Augusta, The Stanton Bird Club of Lewiston-Auburn, the Cumberland County Audubon Society of Portland, The John Burroughs Nature Club of Portland, the Josselyn Botanical Society of Maine and the Garden Club of Camden.

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The following thirty eight species of birds have been known to nest in the Knox Arboretum: Spotted sandpiper, woodcock, ruffed grouse, red-shouldered hawk, Cooper's hawk, long-eared owl, golden-winged woodpecker, downy woodpecker, kingfisher, blue jay, crow, rose-breasted grosbeak, white-throated sparrow, chipping sparrow, junco, song sparrow, Savanna sparrow, vesper sparrow, goldfinch, red-eyed vireo, cedarbird, bank swallow, white-bellied swallow, redstart, Maryland yellow throat, ovenbird, magnolia warbler, chestnut-sided warbler, black-throated green warbler, yellow warbler, Nashville warbler, blue yellow-backed warbler, red-bellied nuthatch, black-capped titmouse, olive-backed thrush, Wilson's thrush, hermit thrush and robin.

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The green earth sends her incense up from many a mountain shrine; From folded leaf and dewy cup she pours her sacred wine.

—Whittier.

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Oh Nature, gracious mother of us all, within thy bosom myriad secrets lie, which thou surrenderest to the patient eye that seeks and waits.

Margaret J. Preston.

# The Knox Academy of Arts and Sciences

A State Association of Scientists, Naturalists, Nature teachers and students and artists to encourage a more wide-spread interest in these fields of human effort, to carry on research work in all branches of the Natural Sciences and to disseminate amongst the people information in relation thereto.

The success of this institution and its publication—The Maine Naturalist—depends upon the support given them by Nature lovers and public-spirited citizens.

Help to increase the membership and the circulation of the Academy's Journal.

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