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THE OTTAWA NATURALIST.

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THE EGGS OF THE SCARLET WATER-MITE *(Hydrachna sulcata)*.

By Prof. E. E. PRINCE, Dominion Commissioner of Fisheries, Ottawa.

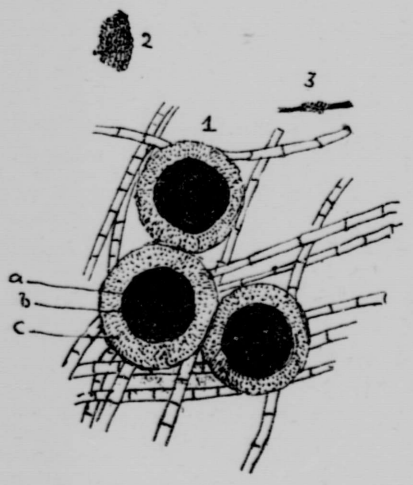
The Scarlet Water-mite *(Hydrachna)* is common in ponds and ditches near Ottawa. On account of its conspicuous coloration it may be readily seen moving actively through the water, or climbing amongst green water-weeds in search of food. Its eggs and spawning habits do not seem to have been described, and in a number of papers on the Acarines or Mites, which I have looked over, I find no reference to its ova. Some of the memoirs which I have consulted (including Edouard Claparède's splendid contribution entitled "Studien an Acariden,"* with ten exquisite coloured plates), describe and figure the ova and early stages of several allied species; but none of them quite agree with the eggs of *Hydrachna sulcata*, which I here describe. I have mounted some of the adults and the ova, in order that I may finally determine them later, as Dr. Wolcott reported to Professor H. B. Ward that in certain Michigan waters no less than 43 species of Hydrachnidæ, belonging to 16 genera, had been obtained in 1893†; and, as our Ottawa region is probably no less prolific, the diagnosis of specimens demands very careful examination. Owing to the limited amount of work done in the study of mites, any observations upon them, however fragmentary, are of interest. As the Rev. O. P. Cambridge has said, the study of the mites, on account of their small size and obscure modes of life, seems to have been neglected; yet, the variety which characterises their

* Zeitschrift für Wiss. Zool. Band 18, 1868.

† Michigan Fish Comm. Report 1896, p. 15.

forms and habits, renders them peculiarly interesting. They belong, it is hardly necessary to point out, to the class Arachnoidea, which embraces the spiders, mites and scorpions, and includes, amongst other orders, the Araneina or true spiders, the Acarina or mites, the Pœcilopoda or King-crabs, in the opinion of some eminent zoologists, and other interesting groups. To the Acarina belong the cheese-mites (*Tyroglyphus*), the parasitic skin-mites (*Desmodex*), and others which are destitute of tracheæ, or special breathing organs, and the harvest-mites (*Trombidium*), the bird- and beetle-mites (*Gamasus*), the dog- and cattle-ticks (*Ixodes*), and the water-mites (*Atax*, *Hydrachna*, &c.). The possession of an unsegmented abdomen united to a cephalothorax is an important feature in the mites.

In a small vessel, containing various aquatic animals, I had two specimens of *Hydrachna sulcata* obtained in McKay's Lake, Rockcliffe, in May. On June 24th, my little daughter, a very assiduous observer, called my attention to a granular mass, amongst some green *Confervæ*, which had the appearance of microscopic pellets of a bright scarlet hue. Some were attached to a small twig (fig. 3), and an adult *Hydrachna* was seated upon them, apparently in the act of depositing these minute ova. Later in the day two other masses were laid, some being attached to the floor of the vessel. In all, I counted nearly three hundred eggs, and their brilliant colour was exactly that of the parent *Hydrachna*. After being laid, they remained slightly adhesive, as is the case with so many aquatic eggs, and became firmly cemented to each other and to adjacent objects, when the adhesive coat hardened under water. Each egg was perfectly spherical; but,



where the eggs pressed against each other, slightly flattened facets were formed (fig. 1), a feature noticeable in many other eggs, especially the eggs of certain fishes. In diameter each egg was about $\frac{1}{120}$ of an inch, or slightly larger than the mites' eggs described by Claparède, which were about $\frac{1}{140}$ of an inch in long diameter, the form being ellipsoidal in that case. Claparède states that the eggs may be deposited at all times of the year*, but in the case of this Canadian *Hydrachna* the chief spawning period may be in the warmer summer months.

When examined with a pocket lens, the bright red ball of yolk is seen to be surrounded by a dull whitish envelope, the external shell. Under a higher power, say 200 diameters, the red mass or vitelline globe, which is very opaque and dense, is enclosed by a thin skin or layer (fig. 1, *b*) outside of which is the extremely thick external capsule or shell (fig. 1, *c*). This external shell, which I distinguish as the chorion, is either of great thickness or a wide space separates it from the vitelline globe inside. In the hen's egg the yellow vitelline ball is separated by a wide albumen-filled space from the outer white shell; but the shell itself is thin. Claparède, in the mites' eggs which he describes, speaks of a space between the outer shell (his "Schale" or "Dotterhaut") and the contents inside; but, while he describes a thin layer around the dense yolk-ball, the "Keim-haut," which is not really an egg-membrane at all, but a thin layer of germinal protoplasm, he mentions a third layer or skin, which he distinguishes as the "Zwischenhaut"; and the vitelline ball is thus surrounded by three membranes. The outermost is a true chorion produced not by the yolk but by the epithelial cells of the oviduct, whereas a vitelline membrane or zona radiata is always a product of the vitellus or egg itself. The chorion in the egg of *Hydrachna* is hard like horn and extremely granular in appearance, as though studded all over with grains or minute papillæ, each papilla, under a high power, apparently exhibiting a puncture (fig. 2). I tried various experiments in order to prove the existence of pores or canals in the shell, and of a wide space separating the shell from the yolk-ball inside. I subjected some eggs to great pressure under a cover

* Op. cit., p. 451.

glass in order to force fluid through the pores, or to squeeze the yolk-ball out of its central position ; but neither experiment succeeded, and the capsule repeatedly burst. The yolk poured out as a granular fluid, orange or ochre in tint by transmitted light, and destitute of the large spherules, which Claparède described in his mites' ova. Thus the capsule does not appear to be minutely perforated and no space seems to exist inside the shell, or, if it exist, it must be filled by some dense clear substance of which I saw no indication in ruptured eggs. I think that no space exists, and that the apparent space, around the central yolk-ball, is due to the great thickness of the external capsule. Claparède, I may add, specially refers to a space filled with clear fluid, which he considered had entered through the shell from the surrounding water.

To summarise these points, it may be said that the ovum of *Hydrachna* consists of an opaque globular vitellus, bright red in colour, consisting of minute yolk granules and germinal protoplasm; surrounding this ball is a thin skin or pellicle, and enclosing the whole is a thick horny chorion or shell, dotted all over with external granular projections, but whether or not pierced by radial canals, or pores, is uncertain. Embryonic development appears to be slow, and I cannot in this note give any details, but, like all the spider and mite class, there is no true larval metamorphosis, the newly hatched young resembling, in all essential features, the adult, save for the possession of six instead of eight legs. I have constantly found one of the specimens of *Hydrachna* ensconced near the masses of eggs, as though keeping watch over them. Many spiders show parental care, but I could not decide whether *Hydrachna* exhibited such guardianship or whether the scarlet eggs proved attractive merely on account of their bright colour. The body of *Hydrachna*, about the size of a large pellet, is of a rude oval form, the integument is smooth, soft, and deeply creased with irregular folds. Owing to its ceaselessly active movements, the animal is difficult to study in life, the long attenuated snout being protruded and withdrawn, and the whole body changing shape as though it were a bag of soft jelly. The eight legs (not six as in insects) have a thick fringe of hairs on the

inner side, converting them into effective paddles. At the base of the mouth, projecting like a rostrum, are the two simple ocelli, black eye-spots, one on each side, provided with a thick translucent cornea, a thickening of the integument.

Authorities state that *Hydrachna* has no heart, but that the blood is forced from one part of the body to another by the irregular motions of the alimentary canal and the muscles of the limbs, as the animal is most restless and in constant movement. Breathing is effected by small rudimentary tracheæ, though certain mites breathe by means of the skin. Some of the species allied to *Hydrachna* are parasitic in water-beetles and aquatic Hemiptera, others spend all their lives (young and adult) in fresh-water mussels (*Unio*, &c.). Most of them live in ponds and streams, but others, like *Pontarachna*, are marine. The relationship of these interesting creatures to the true spiders, the scorpions, the false-spiders or "harvest-men," the whale-lice or *Pycnogonidæ*, the Chelifers and the Tardigrades or water-bears, gives importance to any feature in their structure or life history. If, as some authorities hold, *Limulus*, the King-crab, be really an Arachnid, the Hydrachnidæ or water-mites, have very ancient phylogenetic connections.

EXPLANATION OF FIGURE ON PAGE 100.

SCARLET OVA OF THE RED WATER-MITE, *Hydrachna*.

1. Three eggs attached by facets to each other amidst Confervæ × 90.
   - *a*. Scarlet vitellus or yolk-ball.
   - *b*. Thin membrane around the vitellus.
   - *c*. Pitted chorion or egg capsule.
2. Portion of external capsule more highly magnified.
3. Group of eggs attached to twig. Natural size.

A NATURALIST IN THE FROZEN NORTH.

By ANDREW HALKETT.

(Continued from page 86.)

Their return from the south to that vicinity was observed early in April, and one or more were seen at intervals between then and the 20th of that month, by which date they had fairly established themselves, and were afterwards to be seen daily, at any hour, flying about, or alighting on the tops of the iglows. During the long sunlit days those little birds, together with the dogs, longspurs, and horned larks, lent a picturesqueness to the group of iglows, and were thoroughly at home, among the snow and ice, even when the wind was blowing strongly.

The nest of the snow-bird is a substantial structure, composed chiefly of grasses lined with white feathers; those found by me were placed under large stones.

A Red-poll *(Acanthus linaria)* was caught on the deck of the vessel when we were sailing along the Labrador coast, and a specimen shot whilst it was flying about among the snow-buntings near the vessel and iglows at Fullerton.

"When you see one raven you need only look round to discover a second." So said Father Brehm, and maybe his statement is based upon fact. One or two Ravens *(Corvus corax principalis)* had made their abode at Fullerton, and were often to be seen singly or together throughout the winter. Not requiring to be disguised from enemies, nor in order to obtain its food, this bird is a conspicuous object, and its jet black colour amid its white surroundings, is no doubt an advantage to it in finding its mate.

The Horned or Shore Lark *(Otocoris alpestris)* was occasionally seen among the snow-birds at Fullerton, and the Snowy Owl *(Nyctea nyctea)* was occasionaliy reported to have been seen in that vicinity. This owl is diurnal as well as nocturnal.

Two eggs, from the same nest, of a Falcon *(Falco)* were found at Fullerton on the 5th of July. In one incubation was advanced, the other was rotten.

The Rock Ptarmigan *(Lagopus rupestris)* was repeatedly seen in various stages of plumage. In the white plumage in the months

of December and May, in variegated plumage in September, and in white or variegated in June. It is not easy to understand this, but I speak of what I saw. Ptarmigan were also seen out at sea—off Labrador—early in October, their tails spread out fan-shape in flight, and their plumage was then white.

We must hurry through the birds. That line of the arctic fauna is too great to do anything like justice to in a single lecture.

Shore-birds are numerous. One day a little Sandpiper tried to decoy me away from its nest by feigning to have its wings broken. It would allow me almost to touch it, and then skip away; after which it repeated its tactics. I sat on a rock and patiently watched it until it returned to its nest, which contained four beautiful eggs.

The Red Phalarope (*Crymophilus fulicarius*)—a bird of wide distribution—is well represented and thoroughly at home in our northern waters. With its coot-like feet it swims gracefully about in the ponds, and equals any duck in its ease of movement, a thing shared with other Phalaropes, but otherwise unique among the shore birds. During the summer it was common at Fullerton, but its nest was hard to find.

The Whistling Swan (*Olor columbianus*) was found at Southampton and Hutchen's Goose (*Branta hutchinsii*), and the Lesser Snow Goose or Wavy (*Chen hyperborea*) at Fullerton.

Eiders (*Somateria mollissima*) was very plentiful, and some remained at the floe or open water throughout the winter, and were frequently shot.

The following analysis of the contents of the gizzards of some 20 Eiders may be of interest:—Numerous shells of *Acmæa testudinalis*, numerous fragments of valves of *Tonicella marmorata*, a few shells of *Margarita cinerea*, a number of shells of other small gastropods, a few opercula of a gastropod, egg-capsules of a gastropod, numerous valves of *Crenella*, fragments of valves of various small and medium-sized lamellibranchs, various parts of the shells of *Hyas* and other crustaceans, a few pieces of the arms of an ophiurian, a few bones of a very small teleost, fragments of alga, numerous small stones.

The King Eider (*Somateria spectabilis*) was of rarer occurrence than the common Eider, but was occasionally seen. A male bird

I came across suddenly during one of my walks, resting on the water, and, as it shewed no inclination to get out of the way, I had for a few minutes a splendid view of it.

The Long-tailed Duck, Old Squaw, or Sou-wester (*Clangula hyemalis*) was common at Fullerton, where during the long days it was to be seen at any hour among the fresh water ponds, and to be heard uttering its distinctive cry: *ha-how-wa.*

The nest of this bird is a beautiful object—composed of grass, thickly lined around the sides with down and sunken in the turf. The eggs, which are of a pleasing buff colour when seen in the nest, add to the appearance of the object.

Terns' eggs were brought to the vessel by the natives promiscuously. There is a considerable variation in the markings of the eggs, and they may not all be of the same species, although mostly to be referred to the Arctic Tern (*Sterna paradisæa*), which was the species of tern most commonly seen.

The American Herring Gull (*Larus argentatus smithsonianus*) was to be seen anywhere in the northern part of Hudson Bay, in the Straits, and along the coast of Labrador.

Besides the Herring Gull, several other kinds, notably Jaegers, which may be considered the birds of prey of the Laridæ, or Gulls, were found.

The little Dovekie (*Alle alle*) is one of the most boreal of birds. It was plentiful in Davies Straits, and in the far north, to be seen gregariously in isolated flocks, or singly, flying, diving, or swimming. At Eath, Greenland, it was also seen, flying in flocks high up in the air.

Murres (*Uria lomvia*) were numerous at Coates Island, and all through Hudson Straits. They were doubtless hatching their eggs in the near vicinity to the vessel at Wolstenholme; but, owing to the ice jam, there was no way of getting near them.

Sea Pigeons (*Cepphus mandtii*) were seen off the coast of Labrador; in proximity to the low and rugged islands situated at the entrance to French Head Bay; and at Winchester Inlet. They were quite common at Fullerton, and were occasionally shot at the open water. They were also seen at Beechy Island.

Red-throated Divers (*Urinator lumme*) and Black-throated Divers (*U. arcticus*) were found at Fullerton.

Of Fishes, small Salmonoids were seen jumping at the mouth of the river at Nachvak. The Salmonoids are numerous, at least in individuals of particular species, in the far north, and were frequently caught through openings in the ice at Fullerton. Hundreds of Salmonoids were netted at Pond's Inlet. The stomachs of those were crammed full of amphipods. A small trout was caught with the hand in a stream at Port Burwell. Cod-fish (*Gadus callarias*) were caught with the gigger at Port Burwell, and a number of small Gadoids was found at Fullerton. A specimen of *Lycodes*, and one of *Gymnelis*, were dredged at Port Burwell, and a few specimens of two species of Blennioids at Fullerton. A Sand-launce (*Ammodytes*) was found at Eric Cove, lying on the beach at low tide, out of the water, and was alive, and no doubt was awaiting the return of the tide. Cottoids or Skulpins were numerous, and were the most common of the marine fishes observed. Great numbers of a species of fresh-water Stickleback were found in the ponds at Fullerton. A Basking Shark (*Somniosus microcephalus*) was seen in the hands of the Esquimo at Port Burwell.

Several specimens of Ascidians or Tunicates were dredged. Among them two of *Boltenia*, one at Port Burwell (small), the other at Fullerton (large). The latter is of a red colour, and the stalk is covered with *Spirorbis*, Polyzoans, and a bright pink alga.

The crustacean fauna is very rich: the sea abounding with cirripedes, amphipods, decapods, and isopods: the fresh waters with copepods and phyllopods.

Swarms of a bright red-coloured copepod of the family Diaptomida exist in fresh water ponds, formed of melted snow, in the barrens at Fullerton; associated with which are numbers of so called water-fleas and also a species of phyllopod.

These fresh-water crustaceans are probably the modified descendants of primitive kinds which throve in the glacial period; for as G. O. Sars points out, "all the Copepoda pass through some free-living stages, the earliest of which is the well known so called *Nauplian* stage," and, as he clearly demonstrates, "it is easy to believe that the parasitic forms have originally descended from free-living forms," so that "the most primitive characters must be sought for, not among the parasites, but among the free-

living forms." Now these crustaceans, found during the Expedition, are free-living and comparatively highly organized kinds. Furthermore, their occurrence together in the same pond so corresponds with a somewhat similar condition of things which Sars observed in Norway, that I quote what he says: "The only place where I have met with this form [*Diaptomus bacillifer*] is in the farthest north of Norway, at Vardö, Finmark. It occurred here rather abundantly in a shallow tarn situated close to the town. In the same tarn the arctic Phyllopod *Branchinecta paludosa*, was very common, and the water was moreover peopled with large shoals of *Daphnia magna*."

Some conception of the conditions in which those remarkable copepods and phyllopods live and move, may be gathered from the following quotations from my manuscript notes.

"Walked over beyond the first pond, intending to find the opening in the second, but, owing to a blizzard, could not find even the pond. Had on returning to guide myself by the sun which dimly shone through the clouds and snow-drift, and at length saw the house which had been built for the Mounted Police, and so was enabled to make my way back to the vessel. My ears and nose were frozen. These facts are merely introduced because, such being the circumstances under which copepods were looked for that day, some of the conditions under which they were to be sought are thus shewn. Of course they were not to be found, but I knew that under the ice they were swimming about as usual." This was on the 11th November.

Of isopods collected were specimens of the Salve Bug (*Ægapsora*) found on cod-fish, and specimens belonging to the families Idotheidæ and Arcturidæ. Amphipods were exceedingly numerous at least in individuals, and were found in the sea or along the beach almost anywhere, some of the species being very closely allied. Specimens of Cirripedes or Barnacles, of the genus *Balanus* were found; but the Crustaceans are two numerous and require working out, to say more about them just now.

Of Arachnids, spiders of different kinds and sizes were found, under stones or moving over the ground at Nachvak, Eric Cove, Fullerton, and at North Devon Island. Very tiny arachnids (just perceptible) were found at Beechy Island, where Franklin's monu-

ment is. Small arachnids were found under a stone at Wakeham Bay.

Humble or Bumble Bees (*Bombus*) of two species were seen at Fullerton at the end of June and in July, flying over the rocks or hovering among the flowers of the pinkish red moss-campion (*Silene acaulis*), and specimens obtained.

Diptera, chiefly of the families Culicidæ, Œstridæ and Muscidæ, are numerous and common in the arctics during the short summer. Mosquitoes were very thick and troublesome at Port Burwell, and some were caught with the hand on the deck of the vessel. Specimens of mosquitoes in the larval, pupal, and imago stages were also collected at Fullerton. The large larvæ of a fly which I have named the Tooktoo-fly, infest the flesh of the Caribou. Tooktoo is the natives' name for the Caribou. Small dipterous larvæ were found in a small dead bird at Cape Isabella, Ellesmere Land, and dipterous pupæ in the skull of a cetacean at Port Burwell.

The larvæ of Caddis Flies were found common at the bottom of the fresh-water ponds, where they were readily to be seen, crawling along slowly. They were voracious, and those collected kept eating the phyllopods which I had in the same vessel. Their cases were composed of bits of leaves. A specimen of Caddis Fly (imago) was also found.

Further reference to insects collected may be made to a few diurnal moths and caterpillars, to several species of beetles (including aquatic kinds), and to a curiously modified louse, specimens of which were found on a walrus and on a seal.

The time would fail in any effort to describe the various mollusks, polyzoans, annelids and echinoderms, observed or collected during the expedition. The barest allusion can be made to them.

Pteropods were found, mingled sparingly with medusoids and ctenaphores, moving about near the surface of the sea in harbours; and specimens representative of the two sub-classes, viz : Gymnosomata and Thecosomata, into which those mollusks are divisible, obtained. The species found belonging to the latter named division are popularly known as "black-berries."

(To be continued.)

BOTANICAL NOTES.

THE FRUIT OF EPIGÆA REPENS.—Where it grows, there are few flowers so well known as the deliciously fragrant Mayflower or Trailing Arbutus; but in collections there are few specimens which are so uncommon as the fruit of this charming plant. During a recent visit to Youghall, New Brunswick, I had leisure to examine some patches of *Epigæa* which were growing in an open wood of Red and White Spruces. That this plant, which is so enormously abundant over tracts of many miles in extent, must mature vast quantities of seed is shown by its very abundance; for there is perhaps no plant which is so difficult to transplant. Notwithstanding this, I could find only one patch upon which the interesting seed capsules occurred at Youghall. These were in clusters of three to six, in shape turbinate or depressed-globose, roundly five-lobed, glandular bristly, with the pistil in most cases attached and each one surrounded by the pale persistent membranaceous sepals. When ripe, the leathery valves separate at their tips in the centre of the capsule, and gradually curl backwards between the sepals, leaving exposed a central fleshy disk consisting of the five placentæ on the surface of which are the small dark brown, oval, tuberculate seeds so close together as almost to hide the disk.

RARE OTTAWA PLANTS.—On the 1st of July I visited the sand hill on the Rideau River above Hog's Back. In driving along the road after the sand was reached, several plants of *Scrophularia nodosa*, L., var. *Marilandica*. Gr., were found. Close by was a large bed of the beautiful white Convolvulus (*C. spithamæus*, L.) and, farther on, a large patch of *Physalis viscosa*, L. At the top of the sand hill above the river were several large patches of *Monarda fistulosa*, L. This sand deposit itself is of great interest. It is a steep bank running down 100 or more feet to the river and consisting of clean white sand. Dr. Whiteaves tells me that it is the "Saxicava sand," a shallow water marine deposit which immediately overlies the "Leda clay," which is a deep water marine sediment. Perfect specimens of *Saxicava rugosa*, *Macoma Balthica* (formerly called *Tellina grœnlandica*), *Mytilus edulis* and valves of a barnacle, probably *Balanus crenatus* were found.

J. FLETCHER.

NATURE STUDY—No. XXVI.

FIELD WORK AT THE OTTAWA NORMAL SCHOOL SUMMER COURSE FOR TEACHERS.

A. E. ATTWOOD, M.A.

Nature Study was the feature most emphasized at the recent session of the Summer School at Ottawa. During the forenoons two lectures were delivered daily by Dr. J. F. White, Mr. J. H. Putman, Dr. James Fletcher and other members of the Field-Naturalists' Club. The afternoons were devoted to practical field work, the leaders being Dr. J. F. White, Mr. J. H. Putman, Mr. J. F. Sullivan and Mr. A. E. Attwood. The object of this sketch is to record the methods of work and other suggestive features of the daily excursions.

July 4. In spite of the excessively hot weather, over one hundred teachers visited the Arboretum of the Experimental Farm, where they were met by the Director, Dr. Saunders, and the Entomologist and Botanist, Dr. J. Fletcher. After a half-hour's ramble among the trees and shrubs, a halt was made at the coniferous group, where Dr. Saunders gave an interesting address on the evergreens, illustrating his remarks by the specimens at hand. For ornamental purposes he recommended the Colorado Blue Spruce *(Picea pungens glauca)*. He showed how the Norway Spruce *(P. excelsa)* may be identified by its leaves and handsome cones over four inches long. When the teachers had reached the maple group, they were addressed by Dr. Fletcher. He referred to the lack of unanimity among the authorities as to the exact species whose leaf is the emblem of Canada. By breaking twigs of a Norway maple *(Acer platanoides)* he demonstrated the one serious fault of this species for cultivation—its brittleness.

July 5. Serious work was begun at the Britannia outing. The students were divided into four groups, the investigations of each group here and in subsequent excursions being directed by a leader. After a ramble of an hour and a half, all the groups assembled at a place previously selected, where discussions took place and short addresses were given. The subject of trees was considered and the students contributed the following characteristics of an ideal ornamental tree: hardiness and ease of culture; freedom from insect pests; beauty of foliage and symmetry of contour; beauty and abundance of bloom; and usefulness of fruit.

July 6. A profitable afternoon was spent at Rockcliffe. The leaders discussed trees, and the following species were recommended for ornamental purposes in school gardens: Wier's Cut-leaved Maple, Schwedler's Norway Maple, Sugar Maple, Ameri-

can Elm, Cut-leaved Birch, the Rowan trees, White Pine, Norway Spruce, and several varieties of the American Arbor-vitæ or White Cedar. Ten minutes was spent in guessing the plants and animals described in a number of poetical selections read by one of the leaders, the object being to endeavour to appreciate the spirit of the poets in their interpretation of nature

July 7. For illustrations in physical geography, no better region can be found than the vicinity of McKay's lake. On one side is a bank of marl which time and great pressure would convert into limestone. An inquisitive student plunged his magnet into the sand and was surprised to see minute particles of magnetite adhering to it. Some apparently clear water was collected in a bottle from one of the inflowing streams. After allowing it to stand, a distinct sediment was observable : thus was demonstrated one of the agencies tending to the obliteration of lakes. Evidence of the other agency was seen in the gorge cut by the outflowing water through the barrier which separates the lake from the Ottawa river. The exploration of this outlet is full of interest; at and near its mouth are to be seen examples of a canyon, a bay, a delta, a cape, a river, a mountain.

July 10. The teachers took advantage of the invitation of Mr. J. B. Lewis to see his magnificent collection of shrubs and flowering perennials, which have been brought from all parts of the world regardless of expense. The collections of Rhododendrons and Delphiniums were particularly admired.

July 11. The peninsula north of the Little Chaudière rapids was the field investigated. The Red Cedar *(Juniperus Virginiana)* was the most interesting tree observed, and it was gratifying to have evidence of the development of observing powers in the assertions of several of the students that the red cedar resembles a juniper rather than the so-called White Cedar *(Thuya occidentalis)*. Dr. H. M. Ami was present and gave an address pointing out to the teachers illustrations of tilting, outcrop, stratification, syncline, anticline, etc., in the Trenton limestone.

July 12. The Seed Division of the Department of Agriculture was visited, where there was an opportunity of seeing a systematic application of Nature Study. The objects and methods of this Division were explained in a lucid manner by Mr. G. H. Clarke and Mr. L. H. Newman. The teachers were much impressed with the value of careful seed breeding when they were informed that recently a single ear of Indian corn, the product of 56 years of intelligent selection, was sold for $11.

July 13. Two hours were spent in company with the aristocracy of plants in the garden of Mr. R. B. Whyte. The stately beauty of *Lilium candidum* was especially attractive to the ladies. Mr. Whyte's magnificent collection of Poppies was much admired.

Speaking in favour of having a garden, Mr. Whyte said that it gives occasion for the most healthful exercise; that it provides a constant source of pleasure in experimenting with new varieties, and that the exhilaration experienced in originating a valuable new variety was in itself an adequate reward for many years of labour. In this connection Mr. Whyte's two greatest triumphs are the Bresaya gladiolus and the Herbert raspberry.

July 14. The swamp and spring in Beechwood were the chief centres of interest. Specimens of Sphagnum or peat moss were examined. It was characterized as the vegetable equivalent of the coral animal, both forming enormous deposits by living and growing at the top, while dying and consolidating below, rising "on stepping-stones of their dead selves to higher things." A frog was made the subject of examination. In contrast with the the human being, several interesting points were observed; the absence of an external ear, the tympanic membrane being continuous with the skin; the manner of breathing by working the throat muscles, which function as a diaphragm; and the winking of the eye by movement of the lower lid. The death of the frog due to the drying of its skin by being held in the hand, showed that the skin acts as a subsidiary organ of respiration only when it is kept moist.

July 17. The forest belts of the Experimental Farm were visited. Dr. Saunders explained that in one part the different species of trees are mixed, while at another part there are groups of trees of the same species. Insects and fungus attacks are naturally more severe in the latter arrangement. He characterized the white pine as a tree which bears the same relation to the lumberman as the apple-tree does to the horticulturist

July 18. At Blueberry Point the Jack Pine *(Pinus Banksiana)* was undoubtedly the tree that attracted most attention. It was remarked that the teachers were more interested in becoming acquainted with a native tree than with the foreigners represented at the Experimental Farm. At the daily conference at the close of the ramble, as a sequel to the lecture of the morning on "A Flower Garden," a discussion was held as to the characteristics of an ideal flowering plant. The following were contributed: abundance of bloom, suitability for cutting, length of blooming season, beauty and variety of bloom, intensity and purity of colour, delicacy of perfume, beauty of foliage, symmetry of contour, and ease of cultivation.

July 19. As a logical sequence to the talk on Minerals in the forenoon, it was decided to visit the Geological Survey Museum, where an opportunity was given to become better acquainted with the twenty minerals introduced in the morning. The cabinet of precious stones was a great attraction, and the specimens were

examined with an intelligent appreciation which would have been impossible without the previous hour's class discussion. Many questions were asked regarding the fine specimen of meteoric iron. After having seen a real meteorite, the teachers will doubtless satisfy their curiosity by reading up the subject of meteors at their earliest opportunity. Dr. Ami gave a short informal talk to the teachers in which he showed the value of a study of fossils in their assisting to determine whether or not valuable minerals might be found in a given rock formation.

July 20. The little creek east of Britannia was explored for about one mile of its course. Near the mouth was seen the swampy immature flood-plain, while further up-stream an excellent crop was growing on a developed flood-plain. On the outer part of a curve in the stream the bank was much eroded while nearly opposite was observed the usually accompanying sand-bar. It was suggested that the students should teach their pupils to test the fall of a stream by using crossed stakes and a spirit level. A series of miniature rapids was obliterated by moving the stones, and the effect in lowering the surface of the water was readily noticed. The opposite phenomenon was illustrated by referring to Patterson's Creek, part of whose basin is drowned land, due to the backing up of the water by the filling of Rideau Canal.

July 21. Delightful weather, surroundings and addresses characterized the final outing of the Summer School. The rendezvous was near the residence of the Director of the Experimental Farm. Dr. Charles Saunders showed the method of artificial cross-fertilization by using flowers of two different varieties of lily. From this he passed to the cross-fertilization of two varieties of wheat. In breeding wheat three objects are kept in view: earliness in maturing, abundance of yield and quality of flour.

Prof. Saunders showed specimens of a great many different species of oaks. As in the pines, the time required to mature the seed varies from one to two years. The *black* oaks in this particular are *biennial* and are characterized by having *bristles* on the of the leaves, easily remembered by the three initial *b*s.

Mr. Alex. McNeill, Chief of the Fruit Division of the Department of Agriculture, gave a demonstration of two methods of grafting. He recommended for Nature Study work the use of a jeweller's magnifying glass, which permits both hands to be free for purposes of manipulation and one eye for gross observation.

Dr. J. C. Glashan quoted the nursery rhyme, "Pussy-cat, pussy-cat, where have you been," etc., to illustrate that the nature of the objects seen depends upon the nature of the observer. He emphasized the importance to the teacher of the highest of nature studies—the study of the child.

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