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THE *MYXOMYCETES* OR SLIME-MOULDS OF THE OTTAWA DISTRICT; A PRELIMINARY LIST.

By J. W. Eastham, Assistant Botanist, Division of Botany, C.E.F., Ottawa.

For some time past the writer has given such attention as was possible to the study of the plants known by the names of Myxomycetes, Mycetozoa, and Slime Moulds, and on coming to reside at Ottawa in the spring of last year decided to collect and study as thoroughly as the pressure of other duties would permit, the representatives of the group to be found in the locality, in the hope that after a few seasons' work a fairly good knowledge of the Myxomycetes of the local flora might be obtained and the enquiry extended into a wider field. This seemed a desirable object for two reasons. In the first place one or two preliminary collecting trips seemed to indicate that the neighbourhood would prove rich in these organisms, and secondly, there seemed a need for the study of our Canadian species. While no very exhaustive search has been made through the literature of the subject, yet, incidentally, a good many works and papers have been consulted, and so far only one reference to a paper dealing with Canadian species, either from a local or a general standpoint, has been noticed, namely a paper by Mr. C. L. Moore on the Myxomycetes of Pictou Co., N.S. (1908). Some rather interesting data are, furthermore, to be obtained from Prof. Macbride's "North American Slime Moulds", the standard work on the American forms. In this work about 220 species are described as occurring in North and Central America, and of these about 127 are recorded from New England and New York State, an area contiguous with that of Eastern Canada. In the same work, however, only about 25 species are mentioned as known to occur in Canada, and two of these are from western localities. As there seems no good reason for supposing Eastern Canada to be greatly poorer in species than the adjacent territory to the south, it might have been inferred that even a very cursory examination of the district would result in extending our knowledge of the

northern distribution of a number of forms. This surmise was abundantly confirmed by the fact that 28 species were collected last summer in the vicinity of the Experimental Farm itself, and some 40 species are recorded for the district.

It may be considered, in view of the circumstances of the case, that the publication of even a preliminary list of the species observed is, at this time, premature. This would be a reasonable objection if it were sought to emphasize the amount of information gained, rather than to draw attention to the need for much more extended work before a record approaching completeness can be prepared. The vegetative stage of the plants, consisting of a slimy mass of naked protoplasm (the *plasmodium*) is usually concealed in decaying wood, or amongst fallen leaves or other decomposing vegetable matter, and only seeks the light when about to enter upon spore formation. While the fructification is often well exposed in some elevated place, for instance, on a tree stump, it is not infrequently on the underside of a log, amongst leaves, or on small twigs on the ground, and this, taken together with the small size of the sporangia in many cases, makes it necessary to search very carefully if nothing is to be missed. Furthermore, the sporangia are often so delicate that a heavy rain-storm after they have been formed may render the identification of them almost impossible. All these circumstances make it possible to work over a small area very thoroughly at frequent intervals, and yet enter on another search in the same spot with a reasonable hope of meeting with something new. The main purpose of the writer, therefore, in publishing this article is to secure the interest and assistance of those who may have an opportunity of obtaining specimens. It is hardly expected that many persons will collect material systematically, but the knowledge that the local forms are being studied may induce those who are pursuing field-work along other lines, or who are spending a vacation in the country to collect and preserve the specimens they meet with. The country around Chelsea and Kingsmere, for instance, suggests almost inexhaustible possibilities for the collection of these organisms, and summer residents could obtain many specimens with very little trouble.

With regard to collecting it may be said that much better results are usually obtained by a thorough examination of a small area than by superficially looking over one of wider extent. Where the material is found on dead wood a note should be made as to the kind of wood if identification is still possible. In many cases it will be found, however, that the logs, stumps and branches apparently most attractive to the Myxomycete are too much decomposed to admit of any opinion as to their

nature. Owing to the very fragile character of the specimens some kind of small box, such as pill boxes or cardboard slide boxes, is almost essential to ensure their safe conveyance home. Material from the same "colony" only, should be placed in one receptacle to avoid the mixing of spores which would otherwise ensue and render identification difficult. This applies most strongly to specimens which to the naked eye appear alike, as when microscopically examined these may be found to be different species. The remaining space in the box should be packed with a little tissue or other soft paper, or failing this, with leaves, to prevent damage to the material by shaking. The conditions most favourable for a plentiful crop of slime-moulds are moisture and warmth. Frequent showers during warm weather furnish ideal conditions. During the hot, dry weather towards the middle of last summer very few specimens were to be found, while in autumn they once more became abundant. The species in the subjoined list recorded from King's Mt. were all collected in October, and so late as October 28, a species not previously met with was collected, somewhat damaged, but still readily recognizable.

It was at first intended to give a somewhat more extended account of the structure and habits of the members of the group, but on account of their diversity this would necessitate a much longer article than has been thought desirable, and without numerous illustrations would probably not give much help to those unfamiliar with the plants. A series of specimens, however, illustrating all the species here mentioned and some others, has been placed in the Herbarium of the Division of Botany at the Central Experimental Farm, and will be very gladly shown to anyone sufficiently interested to pay the Division a visit. Such an examination of actual specimens will give a much better conception of these organisms than any amount of written description.

A word may be added on the economic importance of the group. As regards most of the species this is quite negligable, but a few are parasitic in higher plants and one is the cause of a very serious disease of clutivated crops. This organism is *Plasmodiophora brassicae* Wor. which attacks a large number of wild and cultivated species of cruciferous plants, its hosts being, perhaps, limited to representatives of this family. Attacked plants first show a peculiar malformation of the root, and later the affected part rots, the plant being stunted in its growth or killed. This disease has received in English the names "club-root", "clubbing", "finger-and-toe", and "anbury", and in French that of "maladie digitoire", designations for the most part denoting the abormal form of the root. It is only

too well known in most parts of the world where cruciferous crops are grown, but in this country its occurrence is only known with certainty in the Maritime Provinces, in some districts of which it is very destructive. At the same time from verbal descriptions occasionally given to members of the staff of the Ontario Agricultural College it would seem that the disease is present in Ontario, although its occurrence cannot be looked upon as established until reports are confirmed by specimens. It would be rather strange if it were unknown here, since in the adjacent State of New York it is a very serious pest, especially in the market gardening districts around the large cities.

Another organism about which enquiries are sometimes made in the belief that it is parasitic, is *Spumaria alba*. The large fruiting bodies (aethalia) of this species, often 2 inches or more in length, are frequently found attached to the leaves and stems of various living plants, and are sometimes found in strawberry plantations. While at the Agricultural College at Guelph the writer received specimens from a strawberry grower who stated that they were present in great quantity on his strawberry beds and killing the plants. No doubt he was wrong in thinking the *Spumaria* parasitic, but the aethalia are easily broken up into a powdery mass of calcareous dust and black spores, and hence objectionable amongst the ripening fruit. In France this source of trouble is sometimes so prevalent that spraying with a solution of potassium sulphide is recommended for it. With the exception of these two, however, none of the species known to occur in this country are of any commercial importance.

In the preparation of the list that follows thanks are due to Prof. Macoun, of Ottawa, and to Prof. Macbride, of Iowa University; to the former for permission to work over a collection of material in the Herbarium of the Geological Survey, and to the latter for assistance in the identification of difficult or doubtful specimens. The additional localities obtained from a study of Prof. Macoun's material are indicated by an (M).

The nomenclature adopted is for the most part that of Macbride's monograph, but in a few instances that of Torrend (*Les Myxomycetes*, 1908) has been preferred. Where the nature of the substratum is not indicated the specimens were gathered on decaying wood.

LIST OF SPECIES.

Ceratiomyxa mucida (Pers.) Schroet.—*Ceratium hydnoides* A. & S. Although an especially careful lookout was kept for this species during the past season the only specimens collected were some immature and doubtful ones from the Boom Rd.,

Chelsea. This was the more noteworthy in view of the fact that Prof. Macoun's collection includes material from a number of places in the neighbourhood. Failure to find it in a season so favourable in many ways as the last may perhaps be ascribed to the periodicity which some species seem to show in the years of their appearance. The following are the sources of Prof. Macoun's material:—Beechwood Cemetery, Rideau Park, Rockcliffe, near Hull, Carleton Place.

Fuligo ovata (Schaeff.) Macbr.—*F. septica* (L) Gmel. Though not abundant as regards number of individuals, specimens were gathered in most of the localities examined, viz., Chelsea, King's Mt., Rockcliffe, Blueberry Point, and several places near the Exp. Farm. The largest aethalium gathered measured about 4 in. by 1½, the smallest less than a fourth of an inch in length.

Physarum sinuosum (Bull). Weinm. on dead leaves and moss near Hull (M); Exp. Farm.

Physarum nefroideum Rost. King's Mt.

Craterium minutum (Leers) Fries—*C. pedunculatum* Trent. On dead Cedar twigs, Dow's Swamp (M).

Craterium leucocephalum (Pers.) Ditm. On a dead frond of *Pteris aquilina*, Exp. Farm.

Spumaria alba (Bull.) D. C.—*Mucilago spongiosa* (Leyss.) Morgan. Plasmodia of this species were met with in great quantity amongst dead leaves in Beaver Meadow, in June. A little later the aethalia were found attached to various neighbouring objects, some on twigs on the ground, some on the stems of grasses and branches of shrubs a foot or more above the level of the ground. None of the aethalia were very large, the largest measuring a little less than two inches by one inch. Aethalia were also obtained later in the season near the Exp. Farm.

Didymium squamulosum (A. & S.) Fries. On grass, dead leaves, bark, etc. Beaver Meadow and Exp. Farm. A gathering of this species made on June 9th was the first material collected in properly matured condition.

Diderma effusum (Schw.) Morgan. Gathered once near the Exp. Farm on the leaves and petioles of a living plant of *Mitella diphylla*. The fructification was chiefly on the lower surface of the leaves, the chalky reticulations of the plasmodiocarp showing a tendency to follow the projecting ribs of the leaf, and also to envelop the stiff hairs occurring on both surfaces, thus giving a peculiar lime-splashed appearance to the Mitella plant.

Diderma reticulatum (Rost.) Morg.—*Chondrioderm reti-*

culatum Rost. On dead leaves, cedar twigs and living fern fronds, Exp. Farm.

Diderma spumarioides Fries. On grass stems and dead and living leaves, Beaver Meadow.

Diderma crustaceum Pk. On dead leaves and bark, Exp. Farm and Beaver Meadow.

Stemonitis maxima Schw. Boom Rd., Chelsea; Exp. Farm.

Stemonitis Smithii Macbr. Exp. Farm. This species and the preceding were gathered a number of times near the Farm, being the ones most commonly met with.

Stemonitis splendens Rost.—*S. Morgani* Pk. This handsome species was only met with once, on a tree-stump near the Exp. Farm. The mass of sporangia covered an area several inches square.

Stemonitis fenestrata Rex. Exp. Farm.

Stemonitis herbatica Pk. Exp. Farm.

Comatricha stemonitis (Scop.) Sheld.—*C. typhina* (Pers.) Rost. Exp. Farm.

Diachea leucopoda (Bull.) Rost. Carleton Place (M), West End Park (M).

Reticularia Lycoperdon Bull. Only met with once on a stump near the Exp. Farm. The aethalium was a large one measuring about 2½ in. in diameter.

Enteridium splendens Morg.—*E. rozeanum* Wing. On twigs, rotting boards and tree stumps. Met with rather frequently in various place near the Exp. Farm; also at Rockcliffe, King's Mt., and Ironsides (M).

Tubifera ferruginosa (Batsch) Macbr.—*Tubulina fragiformis* (Pers.) List. Exp. Farm.

Tubifera stipitata (Berk. and Rav.) Macbr.—*Tubulina stipitata* (B. & R.) Rost. Exp. Farm; Beaver Meadow.

Cribraria sp. One or two species of this genus were collected but were too much weathered to permit of further determination.

Dictydium cancellatum (Batsch) Macbr.—*D. umbilicatum* Schrad. Exp. Farm.

Lycogala epidendrum (Buxb.) Fries. Probably the commonest myxomycete in the district, being found almost everywhere where a search was made. As might have been expected the Old Boom Rd., Chelsea, furnished a very luxuriant crop of this species but at no time during the past season when observations were made, were the aethalia so abundant as in the latter part of June, 1910. At that time one could find large areas

where every foot of the surface of the logs bore scores and even hundreds of aethalia. On account of the comparatively large size of the fruiting bodies and the various bright shades of pink and red which they pass through before attaining maturity, this is one of the species most commonly noticed by the casual observer, by whom it is generally regarded as some kind of puff-ball; a pardonable error when it is recalled that the earliest description was published under the name *Lycoperdon epidendron*.

Arcyria nutans (Bull.) Grev. Exp. Farm.

Arcyria incarnata Pers. Ottawa (M).

Arcyria punicea Pers.—*A. denudata* (L) Sheld. By far the commonest species of the genus last season, being met with in abundance almost everywhere in the neighbourhood of the Exp. Farm in the earlier part of the summer, becoming much scarcer as the season advanced. Also collected at Beaver Meadow and King's Mt.

Arcyria cinerea (Bull.) Pers. Exp. Farm.

Hemitrichia serpula (Scop.) Rost. Near Hull (M).

Hemitrichia ovata (Pers.) Macbr. A small quantity of material of this diminutive species was gathered from the Boom Rd., Chelsea. Macbride describes it as rare and records it only from the States of Maine, Mass.; N. Y., and Ohio.

Hemitrichia vesparum (Batsch) Macbr.—*Hermiarcyria rubiformis* (Pers.) Rost. Exp. Farm. This was the last species collected, material still in fairly good condition being gathered on Oct. 28th.

Hemitrichia intorta List. This was found abundantly around the Exp. Farm during the earlier part of the season and was also gathered at Beaver Meadow and King's Mt. Macbride describes it as rare and lists it only from "Fairmount Park, Philadelphia; Ohio; Iowa." It was certainly the commonest species of the genus here, last season.

Hemitrichia clavata (Pers.) Rost. Carleton Place (M); Boom Rd., Chelsea; King's Mt.

Trichia inconspicua Rost. Exp. Farm.

Trichia varia (Pers.) Rost. Ottawa (M).

Trichia scabra Rost. Ottawa (M), Moore Creek (M), King's Mt.

Trichia allax Pers.—*T. decipiens* (Pers.) Macbr., Quite abundant in places on the Boom Road, Chelsea.

Trichia persimilis Karst. King's Mt.

THE IDENTITY OF THE BETTER KNOWN MIDGE GALLS.

By E. P. Felt, Albany, N.Y.

Recent studies in this group have shown that the old generic reference to *Cecidomyia* has very little significance, since this name has been used by various authors in such a way as to apply to almost any one of 800 or possibly 1,000 species or more occurring in this country. This is certainly not a precise definition, and in view of the fact that species which have been reared and referred to genera are constantly being mentioned in literature as species of *Cecidomyia*, we believe that the following list of some of the earlier named species of gall midges, giving the correct generic reference, will be of material service in advancing stability in nomenclature. These changes, though perhaps distasteful to some, are inevitable, since the majority of American genera at least, represent distinct lines of specialization correlated in large measure with variations in food habits.

TRIBE LASIOPTERARIAE.

Midges referable to this group are usually easily recognized by the thickly scaled costa, subcosta and third vein, the last usually lying near the anterior margin of the wing and uniting therewith some distance before the apex; claws almost invariably unidentate. Many of these midges are dark brown, ornamented with silvery-white markings and live for the most part in more or less irregular, subcortical galls on the stems of both herbaceous and woody plants.

Lasioptera Meign.

Usually brown, white marked species with 16 to 33 sessile antennal segments; palpi quadriarticulate, the 5th vein forked. Mostly inhabitants of subcortical tissues.

Lasioptera vernoniae Beutm. Gall a floral, petiole or midrib deformity on ironweed. On the last two it is about 6 mm. long and oval.

L. vitis O.S. The gall is an irregular, frequently lobulated, succulent enlargement on the leaf stalk, portions of the leaf, particularly near the base, or even the tendrils of grape. It may be two or three inches long and is inhabited by several other species.

L. clavula Beutm. The gall is irregularly clavate, about ½ to an inch long, on the tips of *Cornus* twigs. Within there is

a median gallery inhabited by a large, orange larva. Described as *Cecidomyia*, the present generic reference provisional.

L. ephedrae Ckll. The gall is a fusiform swelling on the twigs of *Ephedra trifurca*. Length ½ inch, diameter about ¼ inch.

L. farinosa Beutm. An irregularly ridged, warty, light brown swelling on the under side of the blackberry leaf and usually along the midrib or occasionally on the lateral veins. Length about ½ inch. This is the undescribed *Cecidomyia farinosa* of Osten Sacken.

L. nodulosa Beutm. Gall an irregular, subfusiform or elongate swelling on the smaller branches of blackberry. Length about 1 inch, diameter ½ inch. Also mentioned by Osten Sacken without description, as *Cecidomyia farinosa*.

L. linderae Beutm. Gall an irregular, subcortical swelling on the twigs of spicebush, *Lindera*, from 1 to ½ inches in length.

L. solidaginis O. S. Gall unknown. The adult is closely related to *L. dorsimaculata* Felt. Listed by Glover as *Cecidomyia*.

L. ephedricola Ckll. Gall a resinous, elongate, lateral, brown swelling on the twigs of *Ephedra trifurca*.

L. tumifica Beutm. Eccentric, irregular, subglobose or fusiform enlargement on solidago stem. Length about 1 inch.

NEOLASIOPTERA Felt.

Separated from the preceding genus by the simple fifth vein. The forms incorrectly referred to Choristoneura by the author in 1907, belong in this genus. The species, like those of *Lasioptera*, live mostly in subcortical tissues.

N. sambuci Felt. Gall an irregular, subcortical swelling on the side of the smaller elder stems. It ranges in length from 1 to 2 inches and may have a diameter of nearly 1 inch. Described as *Cecidomyia*.

N. viburnicola Beutm. The gall is an irregular, subcortical swelling on stems of *Viburnum dentatum*. Length 1 to 3 inches, approximate diameter ¼ inch. Described as *Lasioptera*.

N. cornicola Beutm. Galls very irregular, subcortical swellings with a length of ½ to 1 inch. Described as *Lasioptera*.

N. ramuscula Beutm. Gall a fusiform stem or branch swelling on aster, with a length about ½ inch and a diameter of ¼ inch. Described as *Cecidomyia*; *C. strobiligemma* Steb.

ASTEROMYIA Felt.

Distinguished from the two preceding genera by the uni- or biarticulate palpi and comprising a number of forms earlier referred by the author to Baldratia. These species live mostly

in apparently fungous affected galls on the leaves of aster and goldenrod.

A. carbonifera Felt. Gall oval, dark brown or jet black, ¼ inch long, on the somewhat thickened leaves of *Solidago lanceolata*. This is the undescribed *Cecidomyia carbonifera* of Osten Sacken; also listed as *Lasioptera* and *Baldratia*.

A. asterifoliae Beutm. Gall about ¼ inch in diameter, an oval, yellowish white and dark margined, apparently fungous affected blister on the leaf of *Aster lateriflorus*. Described as *Lasioptera*; listed also as *Choristoneura helena* and *Baldratia fuscoanulata*.

A. agrostis O.S. A cone-shaped abortion of a stem accompanied by an approximation and dwarfing of the leaves of *Muhlenbergia*. Described as *Cecidomyia*, also as *Lasioptera muhlenbergiae* Marten.

TRIBE DASYNEURIARIAE.

A large assemblage of species easily separated from the preceding tribe by the almost uniform absence of scales on costa, and the third vein always well separated therefrom. The antennae are cylindric, never binodose in the male, while the claws are invariably toothed. Antennal segments from 12 to over 20. Palpi uni-to quadriarticulate. Many of the species live in stem or bud galls.

RHABDOPHAGA Westw.

This genus is represented by a great number of large, usually reddish brown forms with 14 or more antennal segments; the flagellate ones of the male stemmed. This group intergrades with *Dasyneura*, the more typical members being separated therefrom by the usually tapering, nearly straight third vein uniting with the costa very near to or at the wing apex. *Rhabdophaga* displays a marked preference for willow, living mostly in subcortical tissues or apical bud galls.

R. triticoides Walsh. Gall an irregular stem enlargement ½ to 1½ inches long and about ¼ inch in diameter, resembling somewhat a head of wheat. Described as *Cecidomyia*. Synonym: *C. hordeoides* Walsh.

R. nodula Walsh. Gall a nodular swelling, usually encircling the base of the smaller branches and with a diameter of about ¼ an inch. Described as *Cecidomyia*.

R. salicis Schrk. Gall an irregular swelling on basket willow. An introduced species.

R. batatas Walsh. Gall a very irregular, polythalamous enlargement on the shoots of the low swamp willow. It varies greatly in size and somewhat in shape. Described as *Cecidomyia*.

R. rhodoides Walsh. Gall a large, apical rosette on willow shoots, with the distal third of the central leaves free, while most of the basal leaves are entirely so.. Described as *Cecidomyia*

R. strobiloides O.S. Gall the familiar, rather close, pine-cone-like deformity on willow, some 1 to 1¼ inches in diameter and 1½ to 2 inches long. Described as *Cecidomyia.*

R. brassicoides Walsh. Gall ½ to 1 inch long. A close apical deformity on willow, composed of a series of broad, appressed bud scales. Described as *Cecidomyia.*

R. cornuta Walsh. The larvae excavate cylindric holes in the solid wood of the largest willow stems. Described as *Cecidomyia.*

DASYNEURA ROND.

Separated from the preceding by the third vein being straight or curved anteriorly, tapering but little distally and uniting with costa distinctly before the apex of the wing. Species usually dark brown. Food habits somewhat variable, the species living mostly in simple bud or leaf galls.

D. rhodophaga Coq. The larvae occur in buds of cultivated roses. Described as *Cecidomyia*, later referred to *Neocerata.*

D. trifolii Loew. The larvae live in the folded, slightly deformed leaflets of white clover, *Trifolium repens.* An introduced European species.

D. vaccinii Smith. The larvae occur in terminal buds of cranberry. Mentioned by Osten Sacken without description, as *Cecidomyia vaccinii.* The invalid *C. oxycoccana* proposed by Johnson is antedated by *C. vaccinii* Smith, not Osten Sacken.

D. gleditschiae O. S. The larvae occur in the folded leaflets of *Gleditschia.* Described as *Cecidomyia.*

D. pseudacaciae Fitch. The larvae occur in badly deformed, rolled leaflets of the black locust, *Robinia.* Described as *Cecidomyia.*

D. semenivora Beutm. Gall a deformed fruit of violet. Length about ½ inch, diameter ¼ inch, irregular, a variable brown. Described as *Cecidomyia.*

D. rhois Coq. Gall an elongate, oval swelling 5 mm. long on the small roots of poison ivy, *Rhus toxicodendron.* Described as *Cecidomyia.*

D. leguminicola Lintn. The yellowish midge larvae occur in clover heads. Described as *Cecidomyia.*

D. lysimachiae Beutm. Gall a conical, enlarged terminal bud of loosestrife, *Lysimachia.* Described as *Cecidomyia.*

D. serrulatae O. S. Gall a subconic, deformed alder bud ¼ to ½ inch in diameter. Described as *Cecidomyia.*

(To be continued.)

DRINKING WATER AND HEALTH.*

BY FRANK T. SHUTT, M.A., F.R.S.C., DOMINION CHEMIST.

Of the many natural blessings we possess, good health is easily first in importance, if for no other reason than that it enables us to enjoy life—to make the most of life—and to do our duty by ourselves, our families and the State. Good health means something more than freedom from disease and pain, it implies strength and activity, physical and mental, to do our work in the world and to do it at our best. It is indeed something to be prized and well guarded, for it is easier to maintain than to get back again once having lost it.

While still enjoying good health it is doubtful if we recognize the obligation—the religious obligation I might call it—to protect and preserve our health. To do so we must oftentimes be willing to forego temporary pleasure and enjoyment. Too many take little heed, until perhaps they come to middle life or later, of those things and conditions that contribute towards the conservation of health. Perhaps a better day is dawning. The fundamentals of hygiene are being taught in our schools and the rising generation should know something of the laws of health. Hitherto, as a people, we have had to pick up here a little and there a little, oftentimes learning by bitter experience —and perhaps too late. Forewarned is in a large measure to be forearmed. At all events those who are to take our places will not be able to urge ignorance in matters relating to food, water, fresh air and a great many other things all closely connected with the preservation of health.

But I would point out that a knowledge of these things, necessary as it is, will not in itself be sufficient, there must be the desire to profit thereby, to put it into practise. And with all there must be the exercise of common sense, nothing can take its place. We shall find if we will only cultivate this gift it will help us along very satisfactorily many a time when science is apparently silent as to which path to choose, what action to take.

Our health, as we all must know, is largely dependent upon the character and amount of the food we eat and its freedom from adulteration, the purity of the water we drink, the freshness of the air we breathe, and the character of the exercise we take or of the work we do. To-night we are to consider one of the more important of these factors—the water we use for drinking purposes.

* A condensed account of a lecture delivered before the Ottawa Field-Naturalists' Club, Ottawa, January 9th, 1912.

The water we drink may become, does in part become, part and parcel of ourselves. The metabolism always going on within us and resulting in growth, in the repair of waste, in the production of energy, requires that every tissue of the body should possess water. Thus, the blood that bathes every tissue, and constitutes about one twelfth of the body weight, is about 80 per cent. water. Of the body weight about 60 per cent. is water. The adult individual requires five to six pints of water, or its equivalent, daily. The consumption of certain foods, such as milk, which is 85 per cent. water, of fruits and vegetables which have a high water-content, lessen the volume necessary to take as a beverage.

With this knowledge of the part played by water in the animal economy and its presence everywhere throughout the system, it is not difficult to understand how polluted, foul water may affect health. We are all aware now-a-days that certain diseases, zymotic diseases as they are termed, are caused by specific bacteria or germs. It may suffice to say these pathogenic bacteria having gained an entrance into the system, through the water we drink, the food we eat or the air we breathe, may and often do cause disease within us. It is the function of the phagocytes, or white corpuscles of the blood, to combat with and destroy these germs, and in good health, when we have strong vitality, they perform their function well and keep us free from disease. But, with a lowered vitality when the host of intruders is too great and strong to battle with, they may be beaten in the warfare and we succumb. Among water-borne diseases the one we have to fear most is typhoid fever. The excretal discharges of its victims are loaded with its bacilli and when such waste finds its way into a water supply the disease is disseminated and an epidemic results. Herein lies the chief and great danger in using a supply polluted with sewage or execretal waste. It must, however, be added that water is not the only vehicle which conveys this disease; the ubiquitous house-fly, as we know, must now bear its share of the blame.

But there is another danger in impure water, though of this bacteriology takes no note. I refer to the presence of certain poisonous substances, the products of the decomposition of organic matter—either of animal or vegetable origin. There is good evidence that such polluted water may cause headache, nausea, indigestion, diarrhoea, lassitude and generally lower the vital tone of the system. It is quite true that such toxic compounds have not been isolated, but I might answer that such is the case with many ptomaines, organic compounds occasionally occurring in our foods—and especially in those

which have been stored. Such foods may be and frequently are consumed with fatal results. There is every reason to believe that certain waters and more particularly stagnant waters in which there is decaying vegetable and animal matter, possess this poisonous property. Some of us may have experienced the nauseating effects of water from a pond or lake containing the products of decaying algae It is scarcely necessary to add that such water is unfit for consumption. Moving water is, as a rule, free from this class of impurity. This is a phase of the water question that has not received from sanitarians the attention it deserves, but I am convinced of its importance in judging of the merits of a water for a city or house supply.

So far we have learnt that what we have to fear in our water supplies, is, first, the presence of disease germs, due to contamination with sewage, and secondly, those products of the decay of organic bodies from certain classes of matter, excretal or vegetable and which exert a toxic action on the system. A third form of pollution met with is the waste waters of manufactories which are run into the water course without proper purification. These refuse waters may contain organic or inorganic substances detrimental to health. Fortunately in Canada this kind of pollution is not often found, but in the protection of our lakes and rivers legislation must take cognizance of it and the laws preventing the discharge of such waste into possible sources of water supplies rigidly enforced.

In considering the role of rain and snow in Nature some two years ago, we learnt two facts of a fundamental character. The first was that the earth's moisture was in continual circulation. The ascension of water in the form of vapour, due to the heat of the sun, went on constantly, day and night, winter and summer, from earth and water surface alike. Ice and snow, as we saw, could be converted into vapour without visually passing through the liquid state. This vapour of water ascends until it reaches the higher and colder strata of the atmosphere where it is condensed to fall as rain, hail or snow, according to the atmospheric conditions prevailing at the time of the precipitation. This process of evaporation and condensation—distillation, in fact—is from the point of view we are considering to-night one of the greatest importance, for it is primarily one of purification. The sun, then, is the agent above all others that renders it possible to obtain a wholesome supply of drinking water, for the water in being converted into vapour leaves behind all those substances—mineral and organic—which it held in solution and descending gives us one of the purest forms of water found in Nature.

And, secondly, it was apparent that all our water supplies —lakes, streams, springs and wells—were directly dependent upon the fall of rain and snow, and therefore there was a very close relationship between the annual precipitation of a district and the volume of water which might be available for a water supply.

There are two properties of water that must be referred to, if only briefly, in order that we may intelligently consider the various classes of water that are suitable and wholesome for domestic use—its solvent power and its carrying power. Water is known as the universal solvent. It is because of its ability to dissolve gases and solid substances, whether they be inorganic (mineral), or organic, and the constant exercise of this power that in Nature there is no such thing as pure water —that is, chemically speaking. Pure water, as formed in the laboratory, consists solely of oxygen and hydrogen. All natural waters then, contain dissolved matter, some more, some less, and, speaking broadly, the nature of this matter—whether injurious or harmless to health—and its amount, will be determined by the character of the rock or soil it passes over or passes through. Thus we have soft waters from the Laurentian districts because the gneisses and granites are not easily soluble and impart but little mineral matter to the water; and we have hard waters in limestone districts, because the water with the aid of the carbon dioxide it has taken from the atmosphere is capable of exerting a very considerable solvent effect upon such rocks and contains as a result more or less lime in solution. Next to the sun, the soil is Nature's greatest water purifier, for it can remove by oxidation and filtration impurities in solution and suspension, but if the soil is choked with filth then the water in passing through it will dissolve such and be rendered foul.

The carrying power of water is secondary to its solvent power in this consideration of natural waters for drinking and household purposes. The descending rain, the storms, the spring freshets and floods, wash the surface of the land and carry much which they find there to the nearest stream or lake. Similarly the banks and channels of streams are eroded—even rocks may be slowly worn away and the detritus, the debris, borne in the turbid waters, perhaps hundreds of miles, to be deposited as their velocity is checked. In this way deltas of clay and silt and fine sand mixed with organic particles are formed at the mouth of great rivers, and areas of vast size and of extreme fertility built up. Since turbid waters, those with clay and silt in suspension, are not desirable for supplies, they must be subjected to filtration. If such waters possess no organic filth, the filtered and now clean water will be quite satisfactory.

(To be continued.)

LECTURES.

On December 12th, 1911, Mr. Alex. McNeill, President of the Club, addressed the members, in the Assembly Hall of the Normal School, on "Some Insect Friends and Foes." The attendance was good and the address was much enjoyed by those present.

Mr. McNeill explained that "Insect Friends and Foes" was not intended primarily as an entomological lecture. It was intended, in fact, as a suggestion for a more rational educational training for young people. The lecturer took the ground that inasmuch as physical strength could be developed only by the exercise of the muscle and intellectual strength by the exercise of the mental faculties, therefore, that was the best instrument of education that offered the larger number of opportunities for physical and mental exercise. Books and the ordinary routine of school work offered few opportunities for mental exercise within the scope of the immature intellect. Books were indeed indispensable in all advanced intellectual development, but as an instrument for education with children they had proved entirely inadequate. To illustrate the advantages that natural science offers, the lecturer introduced a large number of lantern slides giving numerous interesting phases of insect life and their co-relation with the every-day affairs of the fruit grower and farmer. The relation of insects to the pollination of flowers was illustrated, with diagrams of the flowers of the Clover, Iris, Ladies' Slipper and Yucca. The usefulness of the hymenoptera in the pollination of the apple blossom was illustrated by several pictures.

The development of the ordinary codling moth from the full grown larva, found all too frequently in Canadian apples, to the perfect moth, was given as an easy exercise and a most interesting one showing the various changes in the life of the insect. Reference was made in connection with each of this series of pictures to indicate the ease with which this could be turned to use as an instrument of education with even the younger children of public schools, and, of course, it was pointed out that the pupils never outgrew the problems upon which they could exercise their observi g and reasoning faculties; so that from the very youngest pupil to the most mature student, field-naturalists' excursions offered material for the most rational intellectual exercise.

Attention was also drawn to the Field-Naturalists' Club excursions in developing a love for outdoor life, with enthusiasm for pure air, pure water and sunshine.

The Ottawa Field-Naturalists' Club.

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