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THE OTTAWA NATURALIST

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INFANT CANNIBALISM AMONG ANIMALS.

By Professor Edward E. Prince, Dominion Commissioner of Fisheries, Ottawa.

In a paper which I read to the Royal Society (Sect. IV) in May last I dealt with the two series of phenomena grouped under the somewhat forbidding titles, polyembryony and pædophagy. They may be regarded as the two opposite extremes of embryonic evolution and the survival of the fittest. In the former (polyembryony) we find that a few eggs give origin to an excessive number of young, while, in the latter, very few young result from a large number of eggs. Biologists have generally accepted the late Dr. W. B. Carpenter's definition of an individual animal as the total product of a single ovum, but our ideas of the potentialities of the egg will require revision with the foregoing phenomena before us, and in my Royal Society paper I ventured on some suggestions as to the significance of recent observations, very curious ones, made by certain biologists, Dr. Gilchrist, Dr. Sylvestri, Marchal, and others, which I intend to publish with plates ere long, but in the present brief article I shall deal only with pædophagy, avoiding technical terms as far as possible.

Fifty years ago Dr. Carpenter, one of the profoundest and most philosophical physiologists and morphologists of the 19th century, discovered that, from the numerous eggs (500 or 600 at least being produced by one parent each season), of that common sea-shore mollusk, the dog whelk (*Purpura lapillus*), not more than thirteen to twenty embryos finally emerged into the open water. To quote the succint description of Carl Claus, "The Prosobranchs enclose their ova in capsules attached....to each other or to foreign substances. Each nidamental capsule of the group shows an aperture, and contains a certain number of vitelline globes or eggs, floating in clear jelly-like albumen. Only a portion of these develop into embryos. One only may,

in an extreme case, finally quit the ovigerous capsule."* Koren and Danielsson in 1857 studied the eggs of the large whelk (*Buccinum*) and decided that many eggs united to form one large embryo, the remaining eggs dying and breaking up; but, immediately after the publication of the Danish observers' views, Dr. Carpenter gave the correct account of the strange phenomenon, an account supported by the later researches of Dr. Dyster. Part of the eggs are fertilized and part are not fertilized but are devoured by the former while still contained in the capsule. Long before the infant mollusks become active "veligers." or free-swimming larvæ, with a crown of waving cilia, they turn cannibal. Dr. Carpenter noticed that some larvæ did not devour their fellows; but depended for nutriment upon their own stock of yolk-macromeres. These became stunted, and many died. The macromeres, it is hardly necessary to say, are the large segments at one side of the egg, as distinguished from the micromeres at the other side, the latter forming the germ. Selenka confirmed Dr. Carpenter's results but held that the cleavage of the early unfertilized egg was not true segmentation, and inferred that, while the minute features of the yolk, in both kinds of eggs, appeared to be the same, there was no nucleus discoverable in the unfertilized eggs. In the Gastropod *Tergipes ansea* he found that when this irregular segmentation took place, portions of the yolk were thrown off, developed cilia, and became independent moving "cosmellæ," as Von Nordmann called them, and they have been regarded as parasitic in nature. Edouard Clapareda, again, from his study of *Neritina fluviatilis* was able to further confirm Carpenter, and Blochmann discovered, in the same small fresh-water shellfish, that one embryo only may survive out of 70 or 80 contained originally in one capsule. Dr. W. K. Brooks announced, more recently, that in the egg-case of *Urosalpinx*, containing six to twenty ova, many of them are devoured by the others both in the earlier and the later stages of embryonic development. Professor J. P. McMurrich, of Toronto, has confirmed these last results by a study of *Crepidula* and *Purpura floridana*, finding that a number of eggs always break down or disintegrate to serve as food for their surviving brethren. In *Fasciolaria tulipa*, one of the Muricidæ, he noted that four, or five, or six, embryos may ultimately emerge from one nidamental capsule, which originally contains about two hundred eggs. But not only in

*Haacke has stated that in certain Australian Rays (Tryogorhina and Rhinobatis) more than one ovum is contained in one horny capsule, and Dr. Otto Klotz, of Ottawa, brought the same fact to my attention in the huge British Columbia skate (*Raia cooperi*, Gir.)

mollusks has this curious fact of pædophagy long been known it has been noticed among the Crustacea. Thus in *Daphnia*, the delicate water-flea, while the eggs are still in the tubular ovary, the ovigerous cell may divide into four, one of which becomes an ovum and increases in size by devouring the other three. In the Phyllopod *Apus*, the egg when first distinguishable, is not a single cell, but a group of four cells each with a large nucleus. The nucleus in one assumes a different character, becomes clearer, and more rotund, exhibiting two or more large granules or germinal spots, while the three others show a mass of granules in the nucleus. These three nuclei grow rapidly, elaborate food, and feed the fourth cell so that it survives, while they themselves disintegrate. No doubt this strange phenomenon of cannibalism, in the earliest stages of development, may be more widespread than is at present supposed. Botanists have long been familiar with a parallel condition in certain plants. Thus, in the Mistletoe (*Viscum album*), one seed may contain two or three embryo plants. Some years ago Dr. Beard, of Edinburgh, boldly compared the embryo of the highest Vertebrates to a parasite receiving nutriment by a placental arrangement from its parent. About the same time Professor McIntosh, of St. Andrews, published an account of the remarkable features of the ovary in *Zoarces viviparus*, the viviparous blenny, the ovarian walls being complexly folded and richly vascular so that the young fish inside are bathed in a nutritive serum until far advanced in larval life. In making sections of the ovary, and contained young, of that species over a quarter of a century ago, I found what appeared to me to be particles of yolk in the alimentary canal which I had difficulty in tracing to the so-called absorption or inclusion of the yolk-sac. Dr. Scharff, of the Royal Museum, Dublin, was at the same time making a study of the early egg in *Zoarces* and other fishes, and the number of eggs present in the ovary of the viviparous blenny struck me as remarkable if only 12 or 15 young were ultimately produced. Could it be that in some way the non-developing eggs served as food to nourish the rapidly growing larvæ emerging from a limited number of ova? The question presented itself to me. It appeared possible but hardly probable.

Dr. Gilchrist, a distinguished Scottish biologist, and officially in charge of the fisheries of Cape Colony for some years, has shown that such a surmise was not far astray. He has proved it to be true in the South African *Catætyx messieri*, Günther, a fish 1 to 2 feet long, and occurring apparently at considerable depths ranging from 400 to 700 fathoms. H.M.S. "Challenger," in her famous scientific cruise, secured a male

specimen 8 inches long in Messier Straits, but Dr. Gilchrist's specimen 2 feet long obtained in September, 1903, about 40 miles north-east of Cape Point, proved to be a mature female specimen in which the ovaries were very advanced and crowded with reddish spherical eggs, numbering probably not less than 30,000.*

The eggs were formed in the hanging transverse folds of the inner ovarian surface, and later they collected on the floor of the chamber of the ovary. They flowed freely from the fish, and Dr. Gilchrist was led to regard them, at first, as ordinary demersal eggs, deposited by the fish on the bottom of the sea. To his surprise he found, on closer examination, very young fish hatching out within the parent. Eight small larval fish were curled up among the loose ova. In the mouth of one larva he found some oil-globules, and in another a mass of soft food-matter, in which were oil-globules and spots of black colour. The mass was carefully removed and turned out to be part of a young fish which was being devoured by another baby fish, and the rest of the body of the victim was found close to its devourer. Alcock had already made the important announcement that in *Saccogaster*, a deep-sea species, developing embryo fish were found inside the parent and hinted that they fed on the surrounding ova; but Dr. Gilchrist's discovery proved that some embryo fish actually swallowed and fed upon other embryos of the same brood, and thus lived and grew inside the ovarian chamber. The larger larvæ 10 mm. ($\frac{3}{8}$ of an inch) long, lived on the smaller newly-hatched young, not simply upon the surrounding eggs. These larval cannibals showed well-developed breast fins, and anal and pre-anal fin-lobes, but the tail had not any caudal fin-lobes.

Most fish, of course, produce eggs or spawn, and the young develop and hatch after they have been laid by the parent. The formation of the young inside the deposited egg of a fish, may take from 2 days to 6 or 8 months in different species, the shad being an example of rapid development (a few days), while the salmon or trout take a long period of time (many months). But in the parent forms of many viviparous fish the young may be found not only already hatched out and lively, but may be very advanced, and exhibit the almost mature form and appearance. I have frequently examined specimens of viviparous species both on the Atlantic and Pacific coasts, and can confirm Dr. Günther's description that the young, in such fish as *Zoarces*, on the Atlantic, and *Cymatogaster*, on the Pacific, coasts,

*Dr. Gilchrist had in August, 1903, secured a fine specimen 2 feet long.

are so matured at the time of their first extrusion, they swim about with the utmost agility, and Dr. Dowler's remarks on *Pœcilia multilineata* that twenty-two young were packed away in the ovarian sac of the parent, and though no ova were discovered . . . the young fish were one-half inch long, all alike, and exactly resembling the maternal form and proportions. The parent was, it may be added, only 2 inches long. In the sea-perch (*Cymatogaster*) of British Columbia, a viviparous form 6 or 8 inches long, I counted forty-three small, perfectly formed young. They were so advanced and active that when dropped into the sea, just after being extruded from the parent by pressure, they swam away with great agility. It may be that they did not long survive, but to all appearance they were able to look after themselves. Inside the parent I found them closely packed, overlapping each other in the sac, and bathed in a clear serum or fluid, no doubt of a nutrient nature. That they have solid food is very probable in the light of the recent observations just outlined, and though no loose eggs have been noticed in the sac, such eggs may form nutriment for them after their own ball of food-yolk is exhausted.

In the higher orders, the mammals for instance, ova are produced in prodigious numbers each season, even though the young developed and born be extremely few. One author records that over 70,000 primordial eggs are produced annually in a mammalian ovary though the young born may be only one to three in the course of the year.

The survival of the fittest is a principle not applicable only to the mature period of an animal's existence, but may begin with the earliest stages of embryonic and larval life. We see that it finds illustration in the first stages of an animal's life, in the most diverse forms from Mollusks up to Man.

MEETING OF THE ENTOMOLOGICAL BRANCH.

Meeting held at residence of Mr. Arthur Gibson, 9th April, 1908. Present: Messers. Harrington, Baldwin, Letourneau, Metcalfe, Young, Halkett, Fletcher, Wilson, Newman and Gibson.

Mr. Harrington exhibited 2 cases, which contained his Ottawa collection of Chrysomelidæ. Over 100 local species were represented. This collection proved of exceeding interest to all present and much discussion took place on many of the species. Mr. Harrington drew special attention to those species which are of uncommon occurrence, some of which were repre-

sented by only a single specimen. The Chrysomelids, or "leaf-beetles," are mostly short-bodied, and more or less oval in outline. They are all vegetable feeders and some are very injurious. The well known Colorado Potato Beetle is one of the bad pests belonging to this family.

Mr. Baldwin showed samples of several kinds of blank labels which he had received from the American Entomological Co., of Brooklyn, N.Y. It was pointed out that these labels were very cheap and useful, and as this firm advertises in the OTTAWA NATURALIST the members were requested to bear it in mind when making purchases of an entomological nature.

Mr. Metcalfe exhibited a small box containing a number of spiders' nests, from which parasites had been reared. The common local nest, flat in shape and oval in outline, of a satiny brown colour, had been chiefly collected and from these some parasites of the genus *Pezomachus* had been secured. The name of the spider that made the nest was unknown to those present.

Dr. Fletcher showed a very large specimen of the ichneumonid fly, *Ophion macrurum*, which had been reared from the cocoon of *Telea polyphemus*. It was noticed that the Polyphemus cocoon had been punctured by a woodpecker, but the cocoon of the *Ophion* inside had not been injured, doubtless because of its toughness. The little moth shown at a previous meeting by Mr. Harrington, the larvæ of which fed on *Lemna*, was reported by Dr. Fletcher to be *Nymphula obliteralis*, the identification having been made by Dr. H. G. Dyar, of the U.S. National Museum. Dr. Fletcher also exhibited specimens, in fluid, of the larvæ of the Mexican Orange Fruit-worm fly, *Trypeta ludens*, which had been found at Ottawa in a bitter orange, and brought to one of the botanical branch meetings by Mr. G. H. Clark. When first noticed the larvæ were dead and discolored. A list of species of the genera Bombus and Psithyrus from various parts of Canada, which had recently been determined by Mr. H. J. Franklin, of Amherst, Mass., was read by Dr. Fletcher and proved of much interest. Local species included in the list were: *Bombus borealis*, *B. impatiens*, *B. pennsylvanicus*, *B. perplexus*, *B. vagans* and *Psithyrus laboriosus*.

Mr. Young exhibited a large case containing about 900 specimens of local microlepidoptera, many of which had been reared by him from larvæ. It is always a pleasure to look over any of Mr. Young's work, and this exhibit was an extremely interesting one. Many of the rarer or recently described species were pointed out and information given as to the food plants of the larvæ.

Mr. Gibson showed specimens of inflated larvæ of some noctuids, which had been collected at Ottawa, or reared from eggs secured from captive female moths. The handsome larvæ of *Mamestra assimilis*, *Peridroma astricta* and *Cucullia intermedia* were included, and attention was drawn to the remarkable change which takes place in the appearance of the latter larva after it passes its last moult. An interesting orange colour variety of the larva of *Cimbex americana*, which had been found on basswood, was also exhibited.

A. G.

NOTE ON A YOUNG SPECIMEN OF THE SNAPPING TURTLE (*CHELYDRA SERPENTINA*).

A young Snapping Turtle has been received through the kindness of Mr. Capel St. George, of Tramore, Ont., and as it presents certain features which become modified or obscured during growth, the following note may be of interest to the readers of the Ottawa Naturalist.

The length of the specimen from the snout to the tip of the tail is about 4⅜ inches when the creature is fully stretched; the length of the carapace (or upper shell) 1 11-16 inches, the breadth at the broadest part 1¾ inches, and the length of the plastron (or under shell) 1 3-16 inches, the breadth 1⅛ inches. The length of the tail is about that of the carapace, whereas in the half-grown and adult it is proportionally shorter. The carapace is very rugose and ridged, features which gradually become smoother as age advances. The crests on the tail, which are so pronounced in the adult, are rudimentary. The shell is feebly ossified. The skin, as in the adult, is warty; the warts on the under parts of the juvenile being whitish in colour. The under sides of the marginal shields are white with dark dots, and there are white spots at or near the borders of the plastron.

The Common Snapping Turtle belongs to the family Chelydridae of the order of the Chelonia or the Turtles; and it may be pointed out that the comparatively small carapace, the small and cruciform plastron, and the incompletely retractile head, indicate the rather primative character of the family, which contains only two other recorded species: the Snapping Turtle of Mexico and Guatemala (*C. rossignonii*) and the Alligator Snapper (*Macrochelys temminckii*); the latter being the largest of the fresh water tortoises.

The little turtle has been fed at intervals of a few days with dead salmon-trout fry which it eats with avidity.

ANDREW HALKETT.

THE NITROGEN COMPOUNDS IN RAIN AND SNOW.

It may be remembered that one of our addresses at the opening meeting of last winter's lecture course was on "Rain and Snow," the lecturer, Mr. Frank T. Shutt, Chemist of the Experimental Farms, outlining their influence upon the industries, the agriculture and the health of the world.

Perhaps the most interesting part of the paper from the strictly Canadian point of view was the presentation of certain data concerning the nitrogen content of snow—the first of the kind, so far as was known, obtained in the Dominion. The fertilizing value of the "blanket of white" was clearly shown, the 1,000 tons (approximately) of snow per acre which falls during the winter at Ottawa containing a considerable amount of this all important element of plant food—nitrogen—in readily assimilable forms.

For some time past every fall of snow and rain has been analysed at the Chemical Laboratory of the Central Experimental Farm, Ottawa, and in the forth-coming report of that institution further interesting data on this subject will appear. From these results we have been permitted to make the following summary:

For the year ending February 29th, 1908, there fell 24.05 inches of rain and 133. inches of snow, making a total precipitation of 37.35 inches—10 inches of snow being reckoned as the equivalent of 1 inch of rain. The total amount of nitrogen in this precipitation amounted to 4.323 lbs. per acre, and of this approximately 75% or 3.243 lbs. was present in the rain, and 25% or 1.080 lbs. in the snow. We further learn that the solvent action of rain is much greater than that of snow, *i.e.* that rain is much richer, weight for weight, in nitrogen compounds, than snow. Rain, therefore, is the better or more thorough cleansing agent of the atmosphere as regards the ammonia and other gases present that contain nitrogen compounds. Another point brought out by this work is that the first portion of the rain or snowfall is richer than that which falls subsequently and that the period elapsing between the falls has a marked effect on the composition.

Data of a similar character have been obtained in many European and other countries and this work is therefore both useful and interesting for the purpose of comparison. It may be cited as an illustration of one of the many valuable researches undertaken by the Experimental Farm system.

NOTES ON THE SPECIES OF PHÆOCYMA, FOUND IN CANADA.

By John B. Smith, Sc.D., Rutger's College, New Brunswick, N. J.

The species of *Homoptera* were studied by the Rev. C. J. S. Bethune in 1864, and the North American forms were listed and described in the *Canadian Journal*, Vol. X, for 1865;—a publication not easily gotten hold of at the present time. Most of the material came from Port Hope, Canada, and several new forms, from that locality, were described. That paper forms the basis of our knowledge of the American forms to-day, and as I have just finished a revision of the species from fuller material than was available over 40 years ago, a few notes on the species found in Canada or likely to be found there, may not be amiss.

And first, the name *Homoptera*, Bdv., must fall in favor of *Phæocyma*, Hbn., an earlier name for the same generic concept and *Ypsia*, Gn., comes under the same head. *Zale*, Hbn., differs only on minor points and secondary sexual characters; but may be retained as a section of *Phæocyma* in a subgeneric sense.

P. Lunata, Drury. Occurs throughout the Dominion east of the Rocky Mountains, after midsummer and until late fall. This is the largest of the species and extremely variable in colour and maculation. The males are more or less marked with blue and may have the entire terminal area blue powdered, and that is the form described as *edusa*, by Drury, the female having been first described as *lunata*. There is a form occurring in both sexes in which the median area is decidedly yellowish, and that was described as *saundersii* by Dr. Bethune.

P. Undularis, Drury. Redescribed by Dr. Bethune as *nigricans*, which is quite as appropriate a name; for the species is intensely black, besides having the wings crossed by undulating lines. I have seen specimens from the eastern provinces only; but the range is probably as great as that of the preceding species, though it is much less common. It flies in June and July. The variety *umbripennis*, Grt., differs in having the median area of primaries much lighter, with a violaceous tint.

P. Æruginosa, Guenée. Similar to the preceding and occurs with it; but is much rarer. It differs in having an irroration of green or bluish scales and in structure as well.

P. Norda, Smith. A very brilliant species from Kaslo and other points in British Columbia and Manitoba; the type material coming from Mr. J. W. Cockle of Kaslo. It ranges

eastwardly however. Dr. Fletcher having sent me specimens for determination from Ontario. It is the form listed by Dr. Dyar as *calycanthata* from the Kootenai district. Flies in May and June.

P. MINEREA, Guenée. More like *lunata* in appearance and often confused with it. It is more mottled, however, and differs structurally. An easy way to distinguish it is by the date; it flies in May, June and July and disappears before *lunata* comes on the scene. It is found throughout the eastern provinces and mingles with *norda*, which may be confused with it, in Ontario. Dr. Bethune redescribed it as *albofasciata*, a well marked male serving as type. It might be said that in this and the preceding species the males tend to bluish irrorations, especially in the terminal area.

P. LUNIFERA, Hubner. This is a much slighter species than any of the preceding and of a more even gray tint. I have no actual Canadian records; but I have it from the States just south of the line, where it flies with the next species. It will almost certainly be found in Ontario.

P. LINEOSA, Wlk. This has been confused with *lunifera* and resembles it very much. It is yet slighter, usually paler, and without contrasting maculation. I have it from points in Ontario, and from Winnipeg, Manitoba, June to August. It probably occurs throughout the Dominion east of the Mountains.

P. UNILINEATA, Grote. A very characteristic species for which I have no definite Canadian records. It has been generally recorded from Canada and flies in early spring.

P. LARGERA, Smith. Belongs to the series in which the wings are less trigonate and the undulating very oblique transverse lines are replaced by simpler more upright maculation. The types are from Vancouver Island, May 8th, collected by Rev. G. W. Taylor and sent in by Dr. Fletcher, (male) and Winnipeg, Manitoba, sent in by Dr. Barnes (female). These are the only examples of the species known to me.

P. DUPLICATA, Bethune. A much smaller representative of the same series and a very distinct species. It was recorded from Port Hope, by Dr. Bethune, I believe.

P. CINGULIFERA, Walker. I have no Canadian localities; but the species occurs in Maine and other New England States, so will almost certainly be found in the eastern provinces.

P. HORRIDA, Hubner. A common and well-known species which flies from May to August and occurs throughout the eastern provinces and westward, probably to the Mountains.

From the list of species heretofore credited to Canada *P. calycanthata*, Sm. and Ab., must be dropped. It is strictly a

southern species, and the identifications under that name of Canadian material are erroneous.

On the other hand it is more than probable that several other species will yet be found in the Dominion. These are *obliqua*, Gn., *metata*, Sm., *curema*, Sm., *helata*, Sm., *squammularis*, Dru., *benesignata*, Harv., and *bethunei*, Sm. One of the objects of this paper, indeed, is to call the attention of Canadian collectors to this genus and the work that yet remains to be done in it.

ADDITIONAL NOTES TO THE ABOVE PAPER.

BY ARTHUR GIBSON.

As an addition to the above interesting paper by our honoured corresponding member, Dr. J. B. Smith, the following notes, made chiefly from specimens in the collection of insects at the Central Experimental Farm, are presented.

PHÆOCYMA NORDA. Besides specimens from the type locality, Kaslo, B.C., there are in the collection of the Division of Entomology, specimens from Cartwright, Man. (Heath), and Ottawa (Young) The species has also been taken at Chelsea, Que. (Gibson).

P. CALYCANTHATA. In Dr. Fletcher's Entomological Record, 1904 (Rep. Ent. Soc. Ont. 1904), this species is recorded from Kaslo, B.C. As stated in Dr. Smith's paper this record should now refer to the new species *norda*.

P. MINEREA. In the Entomological Record, 1906, (Rep. Ent. Soc. 1906), this species is recorded from White River, Hudson Bay Slope, June 2nd (W. J. Wilson). On further examination Dr. Smith could not confirm this identification, as the specimen was much rubbed and crushed, and might possibly be another closely allied species. The above record had, therefore, better be cancelled.

P. DUPLICATA. This species has been found at Digby, N.S., by Mr. John Russell. One specimen taken there on June 6th, is in the above collection. It has also been collected at Truro, in the same province, by Mr. L. A. DeWolfe. In the Entomological Record, 1904, a specimen of this moth is recorded as having been taken at Wellington, B.C., by Rev. G. W. Taylor. This specimen is the one referred to in Dr. Smith's paper under the name *largera*. *Duplicata*, therefore, must now be removed from the British Columbia list.

P. CINGULIFERA. This occurs at Ottawa. Last year several specimens were taken by Dr. Fletcher, and Mr. Young has also collected it. All the examples were taken in May. At Orillia,

Ont., the species has been captured by Mr. C. E. Grant, on June 10th.

P. OBLIQUA. A single specimen of this species was collected in 1900, at Bristol, Que., by Dr. Fletcher.

P. HELATA. The only Canadian record we have for this insect is a single specimen taken at Ottawa on June 20th, 1907. by Mr. J. W. Baldwin.

METEOROLOGICAL OPTICS.

BY OTTO KLOTZ, LL.D, F.R.A.S.

As we were returning one evening from one of our delightful afternoon natural history excursions, the bright disk of the moon rose slowly from the eastern horizon and soon emerged as a huge platter, arresting the attention and calling forth remarks from every one.

Probably no illusion in the heavens is so apparent as the increased size of the full moon when rising. Every one knows that the disk of the full moon when seen on the horizon appears very much larger than about six hours later when it is in the south and high up in the heavens. One might infer that the moon is a great deal nearer to us when rising than when seen high up in the sky. As a matter of fact, the reverse is the case, for when the moon is above us it is nearer by the radius of the earth, say about 4,000 miles, or 1-60 of its average distance. If there were any question about the delusion, it is very easily settled by turning an instrument onto the satellite and measuring its diameter, when of course it would be found that the diameter was practically the same in the two positions. Quite a different phenomenon is the flattening of the disk of the moon when seen in the horizon, for this would be confirmed by the same instrument that we used for measuring the horizontal diameter. The explanation of the flattening lies in the fact that the nearer we approach the horizon the more the rays are bent or refracted, so that the lower edge of the moon looks relatively higher than the upper edge, i.e., the lower edge is thrown up more than is the upper one, so that the moon looks broader than it is deep, in short its figure is elliptical. But the discrepancy in the exaggerated size of the moon when rising is not due to the refraction of the rays of light. We may state at the outset that the illusion is a physiological phenomenon.

We are accustomed to speak of the sky as the celestial vault,

or dome, or hemisphere. However, if we sweep the sky with the eye from the horizon to the zenith, or the reverse, it will be seen that the dome is not spherical but that it is flattened, the appearance being that it is farther to the horizon than to the point overhead. The preceding is true whether looked at by day or by night, particularly in a cloudless sky. This is easily demonstrated by estimating say the point of the heavens midway between the horizon and the zenith or the point overhead, and then measure with an instrument the elevation of the point of bisection. It will be found that the halving point is only about half as high as it appears to be. The physiological effect of passing the eye from its normal position towards the horizon, to overhead, is to give the impression of a depressed vault or dome, and the arc we bisect is not that of a semi-circle but the segment of a larger circle. Any one who has been in our Rocky Mountains will recall the impression of "the giants towering to the skies," but when we measure their angular elevation we find the "towering" very much lessened; physiological effect, due to our constitution. A similar illusion we may notice in the apparent size of constellations near the horizon.

The most familiar object for this illusion is of course the moon, although the sun shares it equally, but I suppose the most of us see the moon rise more frequently than the sun, reminding one of the man who when asked, if he ever saw the sun rise, answered, "I don't go to bed as late as that."

Many observations and measurements have been made on the sun and moon by setting up a circular disk and viewing alternately, say the moon and disk, always moving to or from the disk until it appeared the same size as the moon, and then measuring the distance to the disk. From such and mathematical considerations it is found that the moon appears of its proper size when elevated between 30° and 35°, while when it is on the horizon it is nearly two and half times larger, and when high up in the sky only about half as large as it should be.

When Coleridge lets the "Ancient Mariner" say:—

> "All in a hot and copper sky,
> The bloody Sun at noon,
> Right up above the mast did stand,
> No bigger than the Moon,"

he gave expression to the fact, just stated above, that our dispenser of life and light, and our satellite appear small when they are high in the heavens.

Now for another phenomenon, that we observed later as the gloaming was receding. Let us paraphrase the well-known couplet into,

"Twinkle, twinkle little star, how I wonder—what makes you twinkle?"

The twinkling or scintillation of the stars has been noticed and noted from ancient times. Aristotle remarks that "the stars twinkle, but the planets do not." Although planets do not scintillate, or do not scintillate as much as stars, yet their twinkling has often been observed. Associated with the scintillation, the sparkling "like a diamond in the sky" is often seen, but this rapid change of color is confined to low altitudes, that is, when the star is not high above the horizon. What seems somewhat puzzling is the fact that when a twinkling star is viewed through a telescope the scintillation ceases, and instead one sees a little disk with ill-defined edge. The phenomenon of twinkling is due to refraction or bending of the rays of light coming through our atmosphere. When the air is "unsteady," this bending becomes unsteady too, with the result that the rays of light from a star are "trembling" and flit to and fro across the pupil of the eye, and make the star twinkle. As a telescope has a very big eye, the object glass, and although the trembling rays fall upon it, it gathers so many that when viewed at the eye-end, the twinkling has apparently ceased, but it makes itself apparent by the little disk of light mentioned above. for it must be remembered that the stars are mere points of light and the most powerful telescope reveals no disk. From this it is obvious why the moon does not scintillate, it has a surface that radiates light, and the individual scintillations from points thereon are drowned, so to speak, in the multitude. As to sparkling, or rapid change of colour, the light, as we ordinarily see it, is white, in reality it is composed of all the colours of the rainbow. These various colours do not bend to the same degree, when passing through our atmosphere, some bend more and some less. From any particular bundle of (white)rays we would receive say only the red rays, from another bundle only the blue and so on; so that collectively we would have the impression of white light, i.e., of all colours combined. This is generally the case when the successive layers of our atmosphere are fairly homogeneous. When, however, this is not the case, when irregular layers of varying densities traverse the air, then the dispersion of the white rays into their constituent colours becomes apparent to the eye, the blending of the colours, or rather of the particular rays which give us the sensation of colour, not taking place so continuously. Hence the star appears momentarily of that colour which is represented by the particular ray that meets the eye. When these irregular conditions prevail in our atmosphere then sparkling besides twinkling of the stars is possible. As these irregularities are mostly confined to the

lower and denser parts of the atmosphere we can understand why stars only sparkle at a low altitude, not much above 30° above the horizon, or about a third of the elevation to the zenith or point overhead. While the twinkling or scintillation is greatest too, near the horizon, and diminishes as the stars get higher and higher, it is not wholly absent at or near the zenith, as is the case with sparkling.

THE OCCURRENCE OF *THYMUS SERPYLLUM* AT RICHMOND, QUE.

By J. C. SUTHERLAND, B.A.

In August of this year (1908) Mr. G. H. Pierce, C.E., of Beechmore Farm, Richmond, brought me a flower specimen which was entirely new to me. As it was, however, plainly a Labiate, I turned to Gray's Manual to identify it. It seemed to answer the description of Thymus Serpyllum, but the given range of this species (E. Mass. to Penn.) made the determination doubtful. I therefore forwarded it to Dr. James Fletcher, stating that the nearest I could make of it was that it was a thyme or a savory. He replied at once that it was the Wild Thyme of England, Thymus Serpyllum, and that its occurrence here at Richmond was interesting in view of the fact that in Macoun's catalogue the only record of its occurrence in Canada is at Truemanville, Nova Scotia, where it is naturalized in an old field. He therefore asked me to furnish a note as to its occurrence at Richmond.

On the 14th of the month, I visited Beechmore Farm, and Mr. Pierce accompanied me to the large field where it was growing. The largest patch was on the east side of a knoll, about a quarter of a mile from the G.T.R. main line and the same distance from the Richmond and Quebec branch of that railway. The elevation is over 100 feet above the railway. The extent of this patch would be about twenty-five feet square, and the plant had spread in a peculiar semi-circular fashion. There were other patches elsewhere in the field of about a yard square, and there were still smaller ones on the west side of the knoll. The latter ones quite plainly owed their distribution to the harrow.

The plant first appeared, Mr. Pierce informed me, some three or four years ago. Its situation makes it improbable that it is an escape from any garden. The only likely source of introduction would seem to be the grass and clover seed which had

been sown in the field several years ago. This assumption, of course, adds the problem as to where the grass and clover seed received the contamination. Possibly other records of its occurrence in Canada may be forthcoming.

From an agricultural point of view, Thymus Serpyllum is not welcome. Its habit of growth here would indicate that it might prove sturdily aggressive. But from the artistic point of view it is very beautiful; and to a Canadian amateur botanist gives meaning, for the first time, to the poet's line, "I know a bank whereon the wild thyme grows."

NOTES ON THE LEPIDOPTERA OF LAKE ROSSEAU DISTRICT, MUSKOKA, ONTARIO.

By ARTHUR GIBSON, Central Experimental Farm, Ottawa.

At the head of one of the many small bays of the above charming lake, the delightfully quiet summer resort of Rostrevor is situated. Surrounded with rich, varied and even virgin woods, it offers many interesting studies to the naturalist. During a three weeks' stay at Rostrevor in September, 1907, the writer spent some time in making collections of the insects of the immediate vicinity. It was late in the season, however, to get any fair idea of the insect fauna of the district, and the weather too, most of the time, was unfavourable. The lepidoptera were given special attention and the following list of species taken is merely presented as a contribution towards a better knowledge of that order of insects occurring in that portion of northern Ontario. It will be noticed that many of the species are common or of widespread distribution, but a few are interesting on account of their rarity or owing to the fact that they are the first Canadian captures of which we have record. The majority of the specimens were collected "at light." Besides the moths which were attracted to the bright acetylene lights on the verandah of the boarding-house, two other kinds of insects were very abundant, viz.: the common and widespread *Polystæchotes punctatus*, and the "lamellicorn" beetle, *Ligyrus relictus*. The former has the habit of flying quietly and lazily, but the latter appeared suddenly from out of the darkness, circling around the lights and making a loud buzzing noise, much to the consternation of the guests.

RHOPALOCERA.

Pontia rapae L. Single specimens of this the well-known Small White Cabbage Butterfly were observed from time to time during our stay.

Eurymus philodice Godt. Several examples flying in a pasture field.

Argynnis cybele Fab.
Argynnis aphrodite Fab.
Argynnis atlantis Edw.
Brenthis myrina Cramer.
These are all common species in Ontario. In the Muskoka district, *atlantis* is probably the most abundant.

Polygonia progne Cramer. A few specimens along a roadside.

Euvanessa antiopa L. The Morning Cloak Butterfly was seen occasionally.

Basilarchia archippus Cram. One taken on Sept. 8th.

Anosia plexippus L. This usually common butterfly was noticeably scarce during 1907. At Ottawa very few specimens were seen, and only one at Rostrevor.

Heodes hypophleas Bdv. A single example on Sept. 16th.

HETEROCERA.

Sphinx kalmiæ S. & A. A nearly full grown larva of this hawk-moth was found on Sept. 15th. It was heavily parasitized by a small hymenopterous fly belonging to the sub-family Microgasterinæ.

Telea polyphemus Cramer. One cocoon found Sept 10th.

Automeris io Fab. A mature larva was beaten from basswood on Sept. 12th.

Lycomorpha pholus Dru. One specimen, Sept. 8th. The larva feeds on lichen.

Crambidia casta Sanborn. Several examples of this widespread species were taken on Sept. 4th.

Hypoprepia miniata Kirby. A few, Sept. 5th.

Hyphantria textor Harr. The work of this, the Fall Webworm, was seen Sept. 1st.

Diacrisia virginica Fab. Mature larvæ of this common arctian, were occasionally seen.

Apantesis parthenice Kirby. Specimens taken almost every evening during our stay. This is doubtless the most abundant tiger moth in Canada. The larva is described by the writer, in all its stages, in the Canadian Entomologist, October, 1905.

Halisidota tessellaris S. & A. A few mature larvæ seen. These caterpillars are general feeders.

Halisidota maculata Harr. Larvæ commonly found on alder.

Halisidota caryæ Harr. Larvæ very abundant in the rich woods of maple, birch, etc., wandering about in search of suitable places to make their cocoons. The caterpillar of this species, known as the Hickory Halisidota, and that of *H. maculata*, known as the Spotted Halisidota, were extremely abundant in Canada and northern United States in August and September. Much anxiety was felt by fruit growers and others in districts where the caterpillars appeared in great numbers. The writer published an account of this outbreak in the Annual Report of the Entomological Society of Ontario, for 1907.

Apatela americana Harr. One parasitized larva was collected, the parasite *Rhogas intermedius* Cress. emerging at Ottawa, Sept. 25th.

Caradrina multifera Wlk. A single specimen taken Sept. 12th.

Hadena modica Gn. Sept. 16th.

Hadena dubitans Wlk. Sept. 3rd.

Hadena devastatrix Brace. Sept. 2nd, 7th, 8th, 9th, 10th.

Hadena arctica Bdv. Sept. 3rd

Hyppa xylinoides Gn. Sept. 16th.

Rhynchagrotis placida Grt. One specimen, Sept. 15th.

Rhynchagrotis alternata Grt. Two specimens, Sept. 15th, 16th.

Peridroma occulta L. Sept. 3rd.

Noctua smithii Snel. Sept. 4th.

Noctua normaniana Grt. Sept. 7th.

Noctua c-nigrum L. Sept. 2nd.

Noctua rubifera Grt. Sept. 12th.

Noctua collaris G. & R. Sept. 8th.

Noctua clandestina. Sept. 10th.

Feltia subgothica Haw. Sept. 9th.

Feltia jaculifera Gn. var. *herilis* Grt. Sept. 9th.

Feltia venerabilis Wlk. Sept. 5th, 15th, 16th.

Porosagrotis mimallonis Grt. Sept. 5th.

Paragrotis fumalis Grt. Sept. 3rd. This species is uncommon in Ontario. The only other record we have is of a specimen taken at Ottawa by Mr. C. H. Young.

Paragrotis messoria Harr. Sept. 16th.

Paragrotis insulsa Wlk. Sept. 8th.

Paragrotis albipennis Grt. Sept. 5th, 8th, 15th.

Paragrotis ochrogaster Gn. Sept. 15th.

Mamestra meditata Grt. Sept. 9th, 16th.

Mamestra picta Harr. Sept. 5th.

Mamestra renigera Steph. Sept. 2nd, 5th, 12th.

Nephelodes minians Gn. This noctuid was the most commonly occurring species and some beautiful clean specimens were taken.

Heliophila unipuncta Haw. Sept. 11th.

Xylina fletcheri Sm. Sept. 8th.

Cucullia convexipennis G. & R. Sept. 2nd.

Gortyna nictitans Bork. var. *americana*, Speyer. Sept. 15th.

Gortyna immanis Gn. Sept. 8th. This is the most northern record we have for this species.

Xanthia flavago Fab. Sept. 16th.

Eucirrædia pampina Gn. Sept. 4th.

Orthosia bicolorago Gn., var. *ferrugineoides* Gn. Sept. 2nd, 15th.

Orthosia euroa G. & R. Sept. 8th.

Drasteria crassiuscula Haw. Sept. 5th.

Catocala ultronia Hbn. Sept. 8th.

Epizeuxis americalis Gn. Sept. 15th.

Epizeuxis lubricalis Geyer. Sept. 2nd.

Zanclognatha ochreipennis Grt. Sept. 5th.

Palthis angulalis Hbn. Sept. 15th.

Datana ministra Dru. Mature larva Sept. 15th.

Gynæphora rossii Curtis. A single larva of what we take to be this species was found, and fed sparingly on dandelion and plantain after my return to Ottawa. The specimen unfortunately died during hibernation, but it resembled very much the larva of *rossii*, which had been received by Dr. Fletcher from Messrs. Percy B. Gregson and Dalton Tipping, of Blackfalds, Alta., and also other examples of the larva which had been brought back from Hudson Bay by Mr. Andrew Halkett, of the Fisheries Museum.

Tolype velleda Stoll. Sept. 9th.

Eupithecia quebecata Taylor MS. Sept. 16th; a recently described new species. This is the first Ontario record.

Percnoptilota fluviata Hbn. Sept. 15th.

Hydriomena contractata Pack. Sept. 15th.

Hydriomena latirupta Walk. Sept. 8th, 16th.

Gypsochroa designata Hufn. Sept. 15th.

Petrophora ferrugata Clerck. Sept. 8th.

Deilinia variolaria Gn. Sept. 2nd.

Haematopsis grataria Fab. Sept. 8th, 9th.

Lycia cognataria Gn. Full grown larva on Striped Maple, Sept. 15th.

Ennomos magnarius Gn. Sept. 15th.

Sabulodes lorata Grt. Sept. 3rd.

Subulodes transversata Dru. Sept. 8th.

Nomophila noctuella D. & S. Sept. 4th, 15th.

Pyrausta fumalis Gn. Sept. 3rd.

Scoparia basalis Wlk. Very abundant; observed at light every evening.

Crambus leachellus Zincken. Sept. 2nd, 5th, 15th.

Crambus præfectellus Zincken. Sept. 4th, 5th, 15th, 16th.

Crambus vulgivagellus Clem. Sept. 8th.

Crambus trisectus Walk. Sept. 2nd, 8th.

Thaumatopsis gibsonella Kearf. MS. Sept. 2nd, 3rd, 4th, 15th. This pyralid was very abundant and specimens could have been taken at light almost every evening. The species was submitted to Mr. Kearfott, who pronounced it new, and it has been described under the above name. Co-types are in the collection of the Division of Entomology at the Central Experimental Farm.

Eucosma confluana Kearf. Sept. 8th, 16th. Mr. Kearfott says the species is common throughout the Eastern States, and that in Ontario it has been taken at Trenton (Aug. 24) by Mr. J. D. Evans.

Acleris nivisellana Walsm. Sept. 7th. According to Mr. Kearfott, this is a common northern species, ranging from Eastern Canada to the Pacific slope, and down to the Rocky Mountains into Nevada.

Aristotelia roseosuffusella Clemens. Sept. 8th.

Machimia tentoriferella Clemens. Sept. 8th. An eastern species some years abundant in autumn. It has been taken at Toronto in September by Mr. H. S. Saunders. Mr. Kearfott tells us that the larvæ make a web on the underside of the leaves of mostly all of our hardwood trees.

Depressaria lythrella Walsm. Sept. 7th. Mr. Kearfott reporting on this specimen says: "Walsingham bred this from larvæ on *Lythrum alatum*, in Illinois. Nothing but the type specimens were known until Beutenmuller sent me larvæ from the Black Mountains of North Carolina several years ago, on a plant which I believe to be the above species. Your specimen matches those bred from Beutenmuller's material, making the third locality so far known. If the above plant occurs in the neighborhood of Rostrevor, I have no doubt my determination is correct." Dr. Fletcher tells me that *Lythrum alatum* is not recorded from so far north in Ontario, but that *Lythrum salicaria* might be there and the closely allied *Nesæa verticillata* almost certainly is.

Collecting in the above locality in June or July, would, I feel sure, be most satisfactory. Mr. Dinsmore, the proprietor, told me that earlier in the season great numbers of insects are attracted to the acetylene lights on the verandah.

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