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No. 4. **1884.** June.

THE Canadian Science MONTHLY.

DEVOTED TO THE INTERESTS OF

THE CANADIAN POSTAL COLLEGE, TEACHERS AND NATURALISTS.

Canadian Postal College of the Natural Sciences.

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A. J. PINEO, WOLFVILLE, N. S.

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It is a disappointment to us that we are unable to make, this month, the enlargement mentioned in our last number. We hoped to have arrangements completed in time, but circumstances have prevented the consummation of our wishes in this particular. We shall be settled, however, in time to issue the July Monthly from our own office, and our readers may look for the enlargement in that number.

We hope that our readers will detect, as a result of the change of printers, no depreciation in the neatness and correctness of the mechanical execution of the Monthly—qualities for which our present printer deserves much credit.

The increase in the size of the Monthly to double the present number of pages will add largely to the cost of publishing. Henceforth twelve numbers instead of ten will comprise a volume. The cost will also be increased by the frequent use of expensive illustrations prepared expressly for the Monthly. It will, therefore, be necessary to increase the subscription price. Our subscribers, however, will receive the Monthly until the close of their present subscriptions without extra charge.

Will our readers kindly send us lists of addresses of such of their friends as would be likely to become interested in the Monthly or in the Canadian Postal College, as we will gladly send to such the prospectus of our journal and circulars giving full information in regard to the C. P. C. Those who wish copies of the above to circulate among their friends will please so inform us and such will be promptly sent.

The report of the C. P. C. is crowded out this month, but will appear in next issue.

Botanical Department.

FERTILIZATION OF FLOWERS.

G. U. Hay, St John, N. B.

Paper I.

The least observant of observers does not fail to notice on a bright summer day what a busy scene a flower garden presents with myriads of insects darting to and fro. The least thoughtful, and they form the majority, are content to accept the somewhat general and hackneyed statement of the poet that those insects pre-eminently the "little busy bee" visit flowers to gather the honey stored up in them. Of course the aim of the poet is to teach a moral lesson not a scientific one, and yet the scientific lessons to be drawn from the visits of insects to flowers are not less instructive and are more wonderful. The bee and other insects visit plants to gather *nectar*. The bee could have here taught the poet a lesson, that the juices that were extracted from the plant had afterwards by skilful labor and patience to be manufactured into *honey*. Again accurate observation teaches us that there is a reciprocity between the animal and vegetable kingdoms, that for what the one receives from the other an equivalent is returned. No better illustration of this truth can be obtained than by closely watching the results of the visits of insects to plants. What seems to be selfish and wholesale plundering on the part of insects of juices necessary to the plant, is not really so. The fact is the plant gets even a greater return from the insect. The greator equivalent lies in this, that the insect bears away from the *stamens* of the plant on which it has just alighted innumerable particles of pollen dust to fertilize the *pistils* of a plant of the same species which it may next visit. Plants are even rivals among themselves as to which shall bid highest to secure the greatest number of insect visitors. These bids for favor may be seen in their brilliant colors or in the even more seductive charm of their fragrant juices. Plants therefore do not object to the visits of insects, but rather encourage them. On the other hand they are endowed with the means of protecting themselves from the attacks of a rabble of small or useless insects which are contented to circle around the flower and purloin its juices. These loafers are debarred from entering some plants by a close fitting calyx envelope, by a net work of hairs, by prickles, or other contrivances. To some plants these little insects are invited by alluring juices, and find when too late that they have crossed a bourne from which no insect traveller returns. Such plants are our common Drosera or Sundew, the Pitcher plant, and others whose insectivorous habits are now pretty well known.

After this somewhat discursive introduction, let me endeavor to show why plants should require the aid of insects in order to fertilize them. Assuming that even the more general readers of the MONTHLY have a clear idea of the structure of the flower, I shall barely refer to the process of fertilization. This is accomplished when the pollen grain, alighting on the stigma of the pistil, penetrates to and fructifies the ovules or rudimentary seedlings. It would at first sight appear that in most phanerogams the design is that they should be self fertilizing, that is, that the pollen of the stamens should fertilize the ovules in the pistil of the same plant. This appears evident from the fact that in most flowering plants the stamens are in close proximity to the stigma, and sometimes bent towards it in such a way as to suggest the impossibility of the interference of any outside agency to prevent its accomplishment. The blossom of the pea is an instance where self fertilization seems evidently intended. Ten stamens closely surround the pistil the whole being nearly enclosed by a pair of the petals. Here it would seem that the design is not only for the flower to fertilize itself but to shut out any interference on the part of insects. Take also the flower of *Kalmia glanca*, in which the anthers of ten stamens are held close prisoners in chambers of the corolla until their pollen is ripened when a smart blow on the flower will set free the imprisoned anthers, causing them to strike the upright style with such force as to break the anther case, scattering the pollen dust. This seems to waft upward and surround the stigma like a little cloud. But it has been proved both in the case of the pea and of the

Kalmia that if they are secured from the visits of insects they will not mature their seeds. Numerous other instances might be brought forward to show that the pistil is very rarely fertilized by the stamens of the same flower; and that where such hermaphrodite flowers do exist, the plants reproduced from them are few and insignificant.

It is not desirable therefore, and we may add that generally it is impossible that flowers should be fertilized by pollen from their own stamens. When the pistil is fuctified by pollen from a neighboring blossom it sends forth stronger and hardier seedlings. There are two ways by which this distribution of pollen is effected, first, by the agency of the wind, second, by means of insects. In the first named, the flowers as may naturally be supposed, produce little or no nectar, have abundance of pollen and are inconspicuous and without showy colors. These *anemophilous* flowers as they are called, shed their pollen sometimes in such masses as to cover the surface of the water in the adjacent pools or streams. The flowers of the coniferae are examples; and the inconspicuous flowers of grasses and the common plantago belong to this class. By far the larger number of flowers belong, however, to the second division, *Entomophilous* flowers, or those fertilized by the agency of insects. They have more or less showy and conspicuous carollas, which secrete nectar. This nectar is in many instances so difficult of access that none but the most highly organized insects, as butterflies and bees, can reach it, and in doing so their bodies are placed in such a variety of postures that they go from the flower as well laden with pollen as with nectar. The insect with its body covered with pollen dust comes in the course of his flight to another flower of the same species and repeats the same process. Rubbing against the stigma, some of the pollen from its body adheres to the stigma and fertilization ensues. Of course such pollen can only fertilize pistils of the same species, but the pollen which the insect has carried away is so abundant and adhesive that it may be carried about by the bee for some time before it be brought in contact with a pistil which it can fertilize. But the fact is insects in quest of nectar visit successively plants of the same species, not to deposit the pollen, but for the more selfish purpose of abstracting juices from similar flowers, to which it is led by an unerring instinct.

Entomological Department.

Conducted by Dr. J. E. White.

PRACTICAL ENTOMOLOGY

IV.

The interruption in the issue of this Journal consequent upon the changes required in its enlarged sphere of usefulness, has not left this department the opportunity of giving one or two papers intended for the instruction of those who, this spring, wish to enter into the pleasure of making a collection. We will, having to omit these, now proceed to give the status of Insects in the animal kingdom as briefly as possible, merely to guide the student on to the right path towards a proper comprehension of their position, and of their near relations above and below.

In the first place the animal kingdom is divided into two great series:

First—Those having no true egg, and no cellular tissues—Protozoa.

Second—Those which are reproduced by true eggs, and which have cellular tissue—Metazoa.

Of the Protozoa, it is not the province of this department to speak, but as Insects belong to one of the seven sub-kingdoms of the Metazoa, it will be necessary to work briefly up to them. First, there are the Spongida, according to the classification of recent authorities, these have been separated from the Protozoa. Then come the Cœlenterata, radiate animals which have a distinct cavity with organized tissue in its walls. These are aquatic, have tentacles around the mouth, and have also minute barbed filaments which may be thrown out for stinging purposes; the Hydra and Sea Anemone belong to this. The Echinodermate are familiar to many, through their representatives, the Star Fish and Sea Urchin. They have a distinct nervous system, oral and anal openings, and alimentary canal. Crinoids, Asteroids, Sea Slugs, etc., are examples.

Next come the Vermes, where first the bilaterally symmetrical bodies appear; also the characteristic annular segments, indefinite in number; no legs. Examples are :—Flat-worms, Round-worms, Trichina Spirates, Thread-worms, Polyzoa, Brachiopoda (bivalves) and Annelides, such as Leeches, Earth-worms and Sea-worms, having bristles on each segment, and horny jaws which can be extended or retracted at will.

Then the Mollusca, with soft body, no joints, sometimes with shell. To this class belong the Lamellibranchs—mussels and oysters; Gasteropods—Snails and Whelks; Cephalopods—Nautilus, Squid, Cuttle Fish, etc.

Then the Arthropoda, a very large sub-kingdom, including animals with jointed legs, as Crabs and Insects. They have bodies of many segments, definite in number, the skeleton is outside, and composed of articulated rings, limbs hollow and jointed, jaws move from side to side, nervous system double, one chain on each side; the skeleton is composed of a dense horny substance known as chitine. Crustacea are water breathing, usually have two pairs of antennæ; Crab, Barnacle, and Lobster are examples.

Arachnida — Spiders. Body in two parts, head and thorax joined in one, and the abdomen; they have eight legs of seven joints each, and have two, six or eight eyes. They are air-breathers, with air sacs and spiracles opening into them. The Acarina or Mites, Pedipalpa, or Scorpions, and Araneina or Spiders, belong to this sub-class. Myriapoda have the thorax and abdomen joined in one, as the Thousand-legged worm and centipede. Then come the Insects. They have head, thorax and abdomen distinct, six legs, jointed, two antennæ, and generally, two pairs of wings; the segments of the body are twenty or less, viz.: head four, thorax three, each having a pair of legs, the wings being attached to the middle and last one, abdomen ten, which move on one another more or less freely; the skeleton is of chitine, and upon the outside of the insect. To the internal surface of the skeleton the muscles are attached. The head holds the organs of sense, the thorax those of locomotion, and the abdomen those of digestion. All the appendages are hollow. The antennæ are between the eyes or in front, and [illegible]posed to have the senses of te[illegible] hearing. The eyes are usually compound, one on each side of the head, and three simple ones or ocelli. The mouth is either for eating or sucking, and is composed of four jaws, mandibles and maxillæ; there is an upper and an under lip, labrum and labium; sensitive palpi are developed on the lower lip, and the lip is prolonged into a tongue or ligula. The wings are of a thin delicate tissue, stretched over a network of tubes; the arrangement of these tubes, or venation, is used to distinguish one genus from another The abdomen in many insects ends in a tube which holds either a sting, as in the Bee, or an ovipositor, as in the Ichneumons. The sexes are distinct, and the larvæ are hatched from eggs. In those of social habits, as Ants and Bees, the workers are neutral, neither sex characteristics being developed.

The classification of Orton is as follows :—

LOWER SERIES - Body usually flattened; prothorax large and squarish; mouth parts usually adapted for biting; metamorphosis often incomplete; pupa often active; larva flattened, often resembling the adult—*Neuroptera, Orthoptera, Hemiptera, Coleoptera.*

HIGHER SERIES—Body usually cylindrical; prothorax small; mouth parts formed for sucking; larva usually cylindrical, very unlike the adult—*Diptera, Lepidoptera, Hymenoptera.*

Mineralogy.

By Prof. S. K. HITCHINGS.

No. III.

BERYL.

This mineral occurs in six-sided prisms, usually without regularly formed ends; color, green, sometimes shading into blue or yellow. Cleavage, across the end, but not distinct. Lustre vitreous, streak white. Hardness 7·5 to 8. Transparent to subtranslucent. Infusible before the blowpipe, and unacted upon by acids Occurs in granite, gneiss, dolomite, etc.

Emerald is the bright green transparent variety.

Aquamarine is of a clear sea-green color. Both of these are highly valued as gems. The finest emeralds come from New Grenada, aquamarines from Siberia and Brazil. The largest beryls are found in the United States. One measuring four feet in length and thirty-two inches in diameter was found at Grafton, N. H.

GARNET.

This mineral occurs in crystals, with 12 or 24 faces, but sometimes massive; color, dark red to brown, or cinnamon; transparent to opaque; lustre vitreous; hardness, 6·5 to 7·5; before the blowpipe, most varieties fuse easily to a dark glass; not affected by acids. In composition it is a silicate of various oxides, the most common being alumina and calcium. Clear varieties are used much in jewelry. The opaque and brittle garnets are quite common in mica schist and gneiss. They are usually quite small, but are sometimes found from one to two inches in diameter. Precious garnets are rarely found half-an-inch in diameter. The first garnets discovered, of much value were found on the Syrian River, in the country called Pegu, in Asia, from whence some are brought now. Ceylon, Brazil, New Hampshire, and several other places, produce fine stones. The carbuncle and the hyacinth of the ancients are supposed to have been the garnet. Pulverized garnet is sometimes used instead of emery for polishing purposes.

TOURMALINE.

Tourmaline occurs primarily in three-sided prisms, terminating in a low pyramid, but is usually found with the edges bevelled or truncated, thus giving 6, 9, or 12 sides to the crystal. The lateral faces are often cylindrically convex. It rarely occurs massive, and is always found imbedded usually in granite, gneiss, schists, or limestone; color commonly black or dark brown, but frequently green, red, yellow, or white, sometimes found red within and green without, or of one color at one end, and another at the other; sometimes transparent, but usually translucent to opaque; lustre vitreous, inclined to resinous; very brittle, fracturing across easily;

hardness 7 to 7·5. In composition tourmaline is a boro-silicate of alumina and magnesia, with a small and varying amount of other metals. Most varieties fuse to a blebby glass before the blowpipe; not decomposed by acids; becomes electrified by heating. Thin transparent plates are used for polarizing light. The transparent varieties, free from cracks, are valued as gems; the finest ones in the world have been found in Paris, Maine; within a few years, $60,000 worth have been found in that place. *Rubellite* is a name given to the red tourmaline; and *Indicolite* to the blue.

Astronomical Department.

Conducted by Professor A. E. Coldwell.

THE STARS.

No. I

It has been thought advisable, now that the Postal College and its exponent, the Canadian Science Monthly, are entering upon an enlarged field of usefulness, to give in this department a series of papers on the stars, with a special reference to their grouping into constellations

The number of stars visible to the unassisted vision on a clear night is about 3,000. The opposite hemisphere containing as many more makes the number that can be seen without a glass about 6,000. These are divided according to their apparent brightness into six classes, called respectively, 1st, 2d, 3rd, 4th, 5th, and 6th, magnitudes. Stars so remote as to be invisible to the naked eye are called telescopic stars. These are classified as far as the fourteenth or higher magnitudes There being, of course, no abrupt transition between these magnitudes, an arbitrary division has been agreed upon for the convenience of astronomers. Twenty (20) are classed as first magnitude stars, 65 as second magnitude, 200 as third, 450 as fourth, 1100 as fifth, and about 4,000 as sixth. The number of telescopic stars is much larger being reckoned by some authorities as high as 20,000,000.

CONSTELLATIONS.

As many of the stars appear in groups more or less symmetrical, these groups from remote antiquity have received such names as their fancied resemblance to some personage or animal would most readily suggest. The term *constellation* is of comparatively modern origin, from *con* together and *stella* a star. These groups now number 109, 50 of which were outlined and named by the ancients. The whole expanse of the heavens is now mapped out into these 109 divisions, and every star is included in one or other of them. For convenience of reference, the individual stars of a constellation are designated by letters or numerals, the stars being lettered in the order of their brightness. For this purpose the Greek alphabet is used; after that is exhausted, the Roman, after that, numbers. Each of the constellations has a Latin as well as an English name, and to designate a particular star, the genitive of the Latin name is used after the letter. Thus the two brightest stars in the constellation Orion are called *alpha orionis* and *beta orionis*. In addition to this mode of designation, many of the stars, especially the brighter ones, have names which have been given to them as individuals, and not as members of constellations. Thus Alpha Lyrae is called *Vega*, Alpha Leonis, *Regulus*, Alpha Canis Majoris, *Sirius*, Beta Orionis, *Rigel*, Gamma Orionis, *Bellatrix*.

Ornithology.

CANADIAN BIRDS.

By Ernest E. T. Seton.

PAPER I.

In this, the first of a series of Ornithological papers for the benefit of the members of the Canadian Postal College, as well as for the general reader, it would be well to begin by definitely settling the question, " What is a bird ?"

In the root idea of a word there will often be found its best definition, and " bird" (formerly "brid") means " the being which *broods* over its young." That is very near the mark, especially when we understand "brooding" as "sitting," not merely "nursing."

Yet there are some reptiles that hatch their own eggs, and some birds which do not. Thus several birds leave their eggs to be hatched by the sun, while the mound-making megapode of Australia hatches its eggs *artificially*, burying them in a mass of leaves, which, by decomposition, generate heat enough for incubation.

A fuller scientific definition would be—a bird is a back-boned, air-breathing, feather-covered, warm-blooded animal with wings, lungs and a complete double circulation; reproduced by shell-covered eggs, fertilized within and hatched without the body.

Besides these there are many other minor characteristics, but many even of these main ones are exhibited by animals of other classes. But a short and sure definition is, a bird is a *feathered* being; for all birds, and none but birds, have feathers.

Now let the reader consider a proposition: Supposing that two kinds of animals have been left on a desert island, do you believe that the kind best fitted to withstand the climate and live on the food there found will be the one that will live and in time possess the whole island, while the weakly kind that cannot bear the climate or get sufficient suitable food will, in time, die out? I can hardly imagine any one saying " No " to this almost self-evident proposition. Then I reply: You believe in Darwinism entirely, for in this lies the whole Theory of Evolution.

Now that we understand each other I may proceed to state that birds are descended from a form of reptiles, and stand in their anatomy between reptiles and mammals. The largest living bird, the ostrich, is closely related to the extinct archeopteryx—a bird which had a long, lizard-like tail, with one pair of feathers at each joint, its wings armed with two free claws, and its bill set with teeth. This shews a near approach to the reptiles, and, in time, fresh geological discoveries may restore many connecting links.

On the other hand, we find in Australia a mammal, the ornithorynchus or water mole, whose young are hatched, the covering, corresponding to a shell, breaking at the time of exclusion. In its beak, its lack of teeth, its claws, spurs, monotrematores, construction, and many points of internal anatomy, it resembles birds. Though it is a mammal its mammæ or udders are of the most rudimentary description, merely a number of glands of the skin which pour out a sort of milk. Then when we remember that young pigeons are partly fed by a milky secretion from the glands in the old one's crop, we begin to see that the line of demarcation between birds and beasts is not so very strong after all.

Now that we know what a bird is we will proceed to examine the different kinds, and to this end it seems inevitable that the ardent student first be wrapped in the wet blanket of scientificism. The pilgrim to the "Palace Beautiful" of birds must at the gates face the "loud-mouthed lions" of classification, and maybe here he will, as in the old story, find little more than terrible sounds.

Though a lover of Nature and her order, I have little partiality for classification of her musty remains, and almost feel tempted to say, "Do not mind such things, but go out into the woods and learn and love." Yet all study, to be successful, must be systematic, so we will begin with the outlines of Dr. Coues' Classification of Birds:

CLASS AVES OR BIRDS.

1. *Sub class—Insessores* (sedeo—I sit) —Aerial Birds or Perchers.
   Order—Passeres—Sparrow-like birds.
   " —Picariæ—Outcasts from other orders, as wood-peckers, etc.
   " —Psittaci—Parrots.
   " —Raptores—Birds of Prey.
   " —Columbæ—Pigeons.
2. *Sub class—Cursores* (curro [curs] I run)—Ground Birds or Runners
   Order—Gallinæ—Barn fowl, etc.
   " —Grallatores—Wading Birds.
3. *Sub class—Natatores* (natator — a swimmer)—Water Birds or Swimmers.
   Order—Lamellirostres—Ducks, etc.
   " — Steganopodes — Cormorants, etc.
   " —Longepennes—Gulls.
   " —Pygopodes—Divers.

First you decide to which sub-class your specimen belongs. If the first, it will most likely be a bird with short legs and neck, loose plumage and the hind toe set on a level with the front ones (unless it be a pigeon or a vulture). If of the second, it will most likely have long neck and legs, with the hind toe absent or set higher on the leg than the front ones, and either some bare skin about the head or the leg bare for a space above what is known as the knee joint (really the heel). If your bird belongs to the third it will have webbed feet.*

Having settled the question of sub-class, the reader will go further and decide the order from the following descriptions:

Order 1 — *Passeres*. — (Passer, a sparrow)—Three toes in front and one behind; no signs of a web; hind toe on a level with the others, and longer than the shortest front toe; hind claw at least as big as middle claw; bill without a cere. *i.e.*, a soft skin round the nostrils and covering the basal half of the bill. This order contains fully one-half of our birds. It includes those which shew the highest organization and all our fine songsters. Most of them are sparrow-like birds, but the order also includes the crows. The raven is its largest member.

Order 2—*Picariæ*—(picus, a woodpecker).—Agree mainly in disagreeing with the members of all other orders. They have either a long bill or scarcely any bill at all. In this we find the wood-peckers, cuckoos, swifts, night-hawks, kingfishers and humming-birds, the last being the smallest known birds.

Order 3—*Psittaci* — (Psittacus, a parrot)—Large hooked bill; toes, two before and two behind; the only North American species being the Carolina parroquet, which never comes to Canada.

Order 4—*Raptores*—(Latin for robbers)—Strong, sharp, hooked bill and claws; nostrils in a cere; great power of flight; mostly large birds; many have slightly webbed toes. Includes the owls, hawks, eagles and vultures. The largest bird that flies is a vulture, the condor of the Andes. The vultures have the hind toe slightly raised

* These definitions are not universally applicable, but the Canadian will find them practical in almost every case.

Order 5—*Columbæ* — (Columba, a dove)—Rather straight weak beak, thinnest in the middle; nostrils in a soft, fleshy membrane; strong, pointed wings. This includes the pigeons, which, like the vultures, differ from the rest of the Insessores in having the hind toe raised.

Order 6—*Gallinæ*—(Gallus, a cock)—Short bent beak; nostril long opening under a membrane, which is bare in some and feathered in others, like barn fowl; head with more or less bare skin (except the quails); stout legs; hind toe small and high up; short, round wings. Includes barn fowl, turkeys, grouse, partridges and quails.

Order 7—*Grallatores* — (Gralla, a stilt)—Nearly all are long-legged, long-necked birds, with the leg bare above the middle joint. This order includes the plovers, herons and cranes—three groups so different that Prof. Jordan has, with good shew of reason, made three separate orders of them. The herons, unlike the rest of this sub-class, have hind toe large and on a level with the front ones. Though so various, you may refer to this order any bird which has the tibia bare, yet is not fully web-footed.

Order 8—*Lamellerostres*—(Lamella, a thin plate; rostrum, a bill)—Web-footed birds which have the bill set with plates that look like teeth. This includes flamingoes, swans, geese and ducks.

Order 9—*Steganopodes*—(Steganos, webbed; pous, foot) — Birds having webs not only between the front toes, but between the inner toe and the back one—the most webbed of all. Large birds with long bills ended in a hook, as pelicans and cormorants.

Order 10—*Longipennes* — (Longus, long; penna, wing)—Web footed birds having the legs about the centre of the body; hind toe very small and raised; long bill; very long and pointed wings. Nearly all are white or light-hued birds. Includes gulls and terns.

Order 11—*Pygopodes*—(Puge, rump; pous, foot)—Feet at the very end of the body; either webbed or with great lobed membranes to each toe; when lobed the leg is like a knife blade; very short wings; generally long neck and bill. Includes the divers and grebes.

It is not expected that the student will set to work to commit this to memory, but will refer to this number as occasion shall require, and so be able to determine for himself the order to which his specimen belongs.

WINTER NOTES ON ORNITHOLOGY.

By Prof. C. B. Wilson.

II.

The second group of Passerine birds is known as the (*b*) "*Clamatores*," or Clamorers, whose consaguinity is chiefly indicated by a harsh voice. This group embraces but a single family, the Tyrannidæ, or Tyrant Fly-catcher, such as the Canadian Fly-catchers, the Phœbe-bird and the King-bird. Though but a single family yet the group is strictly a New World one, and the bird fauna of America has one of its chief features in the number and variety of its Tyrannidæ. Their distinguishing characteristics are ten long feathers (primaries) in each wing, and the fact that the shanks of the legs (tarsi) are completely covered by a series of large scales. Other species are just as truly "fly catching," and resemble the Tyrannidæ in many other respects, but they have only nine primaries, and lack the scales on the front of the tarsus.

None of the Fly-catchers are winter residents, but one, the Pewee or

Phœbe-bird (Sayornis fuscus) is a well known harbinger of early spring, and comes North so early in the season as to be fairly reckoned a winter bird.

Its livery is one of dull olive green above and along the sides and breast, fading slightly towards the tail; top and sides of the head, dark brown; below, dull yellowish-white mixed with brown on the chin, which latter color sometimes extends across the breast; a few dull white feathers on the eye-lids; tail broad and slightly forked.

As soon as the birds have paired, usually by the first of May, they commence building. The nest is placed in a sheltered situation, most often, perhaps, under a bridge, sometimes under a ledge of rock, in a barn, or even in the interstices of an well-wall, six or eight feet down. It is constructed of fine hairs, grasses, roots, moss and like material, plastered together with pellets of mud. It is lined with soft grasses and feathers, on which are laid the delicate eggs. These are usually five in number, of a soft, creamy-white tint, sometimes sparingly covered with reddish-brown spots. Two broods are raised each season, sometimes three, always in the same nest, but the old nest is not used a second year.

As a class the Fly-catchers are the best architects we have. The King-bird (Tyrannus carolinensis), the most widely distributed of them all, builds a nest altogether admirable, using soft cotton and woollen substances, lichens, moss and shreds of birch bark, sparing neither time nor material to render it substantial and warm. The green-crested Pewee (Empidonax Acadicus) sometimes builds its nest wholly of the blossoms of the hickory tree. The Wood Pewee (Contopus virens) always chooses a branch covered with small lichens, and saddles its nest upon its upper surface, so closely assimilated by its own external coating of lichens as not to be distinguishable from a natural protuberance on the limb. It is cup-shaped, a perfect segment of a sphere, and rivals even the artistic nests of the humming birds. There is never a loose end or shred to hang in the wind and catch one's attention. Those nests made in the vicinity of dwellings indicate their neighborhood by a variety of miscellaneous and convenient material, bits of paper, rags, cotton, wool, poultry feathers, yarn, string, etc., but are usually, from this very heterogeneity, coarser and rougher than those farther removed from civilization, which, in this instance at least, has exerted a deteriorating influence.

The food of the Pewee, like that of all the fly catchers, consists principally of insects captured on the wing. From this probably results its well-known partiality to the vicinity of water and to the neighborhood of dwellings, as either of these localities breeds an abundance of insect food. And here, perched on some favorite spot, Phœbe will sit all the morning watching for insects, and continually repeating its simple song. There seems to be a special provision in the wise economy of Nature that these fly-catchers shall seize only those insects that are actually on the wing most of the time, passing from tree to tree or hovering among the shrubbery. They thus leave to the warblers and vireos their appropriate food in those forms of vermin that remain cancealed under the foliage and twigs, and to the thrushes those which haunt the grasses and the ground. Though there is such a multiplicity of bird life there is in this way room enough for all. Nay, even more, each family has its own appropriate place, and is actually needed there, because none other can fill it.

It is a vain and mistaken hope that any species of our birds can be exterminated because of some harmful habit, and their place adequately filled by another species which popular opinion pronounces less injurious; for, though multiplied to infinity, this latter species can never perform other than those offices assigned to it by Nature. A thrush can no more supplant the fly-catcher and destroy the winged vermin than a humming-bird can turn wood-pecker and bore for its insect food in the bark and rotten wood of trees. No, they are every one essential, and not even the universally maligned crow could be altogether spared. There are certain limits, of course, to these needs, but, within the limits, the extermination of any bird would make itself manifest in some pernicious manner, and that, too, in a very short time.

Chemistry.

By J. F. Godfrey.

OXYGEN.

NO. IV.

ATOMIC WEIGHT, 16. SYMBOL, O. SPECIFIC GRAVITY, 1. 1.

Oxygen is the most widely diffused of all the elements, forming one-fifth part of the air by volume, eight-ninths of water by weight, and is a constituent of nearly all the substances that go to form the crust of the earth. It forms about one-half of our planet, and nearly three-fourths of animals and plants.

The name "oxygen" signifies acid-producer from the opinion formerly entertained that oxygen was the essential principle of all acids. It is now known that several of the acids contain no oxygen, and hence we conclude that those acids which contain oxygen do not owe their acidity to that substance.

Oxygen is generally prepared from some oxide or salt containing it. If a little mercuric oxide be heated in a test tube, it will be observed to gradually lessen in bulk, and finally to disappear altogether, while on the cooler portions of the tube a coating of pure mercury will be formed, which, when touched, will roll down the sides of the tube in liquid globules. If a red coal be now placed in the tube it will be seen to blaze quite brightly, showing the presence of oxygen in the tube. But the more common way of preparing oxygen for experiments is by heating potassic chlorate and black oxide of manganese in a flask or retort, and catching the oxygen evolved over the pneumatic trough. Potassic chlorate is represented by the formula $KClO_3$. When heat is applied to this substance the action may be represented by the following equation :—

$$2\ KClO_3 = 2\ KCl + 3O_2.$$

For all practical purposes a common Florence flask will answer for generating oxygen from potassic chlorate. A cheap pneumatic trough can be obtained from any tinsmith. I have used one for some time, made of zinc, about eighteen inches long and twelve wide, and six deep; two cleats should be soldered on to the side of the trough, upon which a shelf is placed, pierced with one or more holes, for the purpose of allowing the gas to pass into the jars. Glass jars of any kind may be used to collect the gas.

Place about two ounces of potassic chlorate, and one-third as much manganic dioxide together in the flask; fasten tightly in the neck of the flask, a cork, which has been pierced. so as to allow the end of a bent tube to pass through it. Place the other end of the tube under one of the holes of the pneumatic trough which has been previously filled with water, so as to completely cover the shelf. Now apply heat to the flask, and in a short time bubbles will be seen to rise through the water. The first of these are air, and should be allowed to escape. If a jar be filled with water, and placed mouth downward over the tube, the oxygen will soon expel the water, and remain in the jar.

Oxygen is an odorless, tasteless, colorless fluid ; it is heavier than air, in the propoition of about 11 to 10; it is the sustaining principle of animal life and of all the ordinary phenomena of combustion. Bodies which burn in the air burn with greatly increased splendor in oxygen gas. If a taper be blown out, and then introduced into the gas while the wick remains red hot, it is instantly rekindled. If a bit of charcoal be affixed to a wire, and plunged with a single point red hot into a jar of oxogen, it burns with great brilliancy. If a piece of roll sulphur be set on fire, and placed in a jar of this gas, it will burn with a beautiful purple-blue flame, and evolve a much more intense heat than when burned in common air. Phosphorus burns with such an intense light that the eye can scarcely bear to look at it. But perhaps the most beautiful experiment of combustion in oxygen is made by means of an iron wire, or better, a watch spring; dip one end of the watch spring into some sulphur, and attach the other to a cork which will fit the neck of the jar containing the oxygen, light the sulphur, and place the wire in the jar, the sulphur bursts into full flame and kindles the iron which burns with great brilliancy, sending forth a shower of white stars, while the melted iron, known as the black oxide of iron, sinks to the plate below.

NOVA SCOTIAN GEOLOGY.

Blomidon Amygdaloids, *in situ and transported.*

Paper I.

By Rev. D. Honeyman, D. C. L., F. R. S. C.

In Situ.

At Blomidon, between Pereau and Scot's Bay, a rock called Amygdaloid was observed in great mass. It is so named as it contains *amygdules* of minerals, having something of the appearance of *kernels of almonds.* This rock was once a *lava*, which, on cooling, assumed a vesicular texture. The cavities were subsequently filled with minerals of various kinds, *e. g.*, Zeolites, Calcites, Chalcedonies, etc.

TRANSPORTED.

Boulders of this rock are to be seen in abundance about Wolfville and the side of the Estuary of the Avon. Upwards of twenty years ago my attention was attracted to the latter lying beside the Lower Carboniferous limestones above the old Avon Bridge. Prof. How told me that they came from Blomidon.

On the Queen's Birthday, 1873, when walking with a friend on the beach of Cow Bay, East of Halifax, I noticed boulders on the shore which I at once recognized as *Amygdaloids* from Blomidon. This circumstance was for some time perplexing. At length in our wandering we reached a head on the East side of the Bay. Here I observed a bluff of clay and stones about 50 feet high, out of which were falling in abundance Amygdaloid boulders of all sizes, replete with amygdules of Stilbite, Heulandite, and other minerals. I also found a boulder of mossagate. Here, then, was the secondary source of the supply of the shore boulders.

GLACIATION.

At the same time, I saw large masses of Cambrian quarzites, *rutted, scratched,* and *grooved* in a striking manner. I at once associated these with exposures of the underlying rocks, Cambrian argillites, which were also *scratched* and *grooved*, and I saw in this association *action* and *reaction*.

At Pleasant Park, Halifax Harbor, are exposures of these rocks, scratched and grooved to perfection; some of these show that the agent was moving southerly, taking the course of these lines, which is S. 20 E., N. 20 W. I defined it on the Admiralty chart, and found that the lines produced pointed directly to Blomidon, touching its brow. A problem was thus presented for solution, and *solved*, after 9 years observation, in 1882. Every bank of drift intervening on the harbor in Halifax, Citadel Hill, Observatory Hill, in H. M. Dockyard, Fort Needham, Navy Island, Bedford Basin, Railway Cuttings, Bedford, Windsor Junction, Beaver Bank, sides of Railway towards Mount Uniacke, contain amygdaloids from Blomidon, the number increasing by nearness of approach to their source. On the line of Railway, East of the Junction, they abound near Fletcher's, and are *not* found beyond the Enfield Pottery. In Halifax harbor they are found on George's Island, Point Pleasant, at entrance to North-West Arm, McNab's Island and Thrum Cap. On the *Atlantic shore*—Devil's Island, entrance to Eastern Passage, East side Cow Bay, Lawrencetown, and *end* at Three Fathom Harbour.

[ERRATTA.—No. 3, page 44, lines 30 and 45, for "microscopically" read *macroscopically*.. Page 45, lines 23 and 36, for "microscopic" read *macroscopic*. For "olivenite" read *olivine* throughout.]

Table of Geological Formations in Nova Scotia and Cape Breton, according to Dr. Honeyman's Researches.

	CENE.	Aqueous, &c.
	....	Post Glacial.
	PLEISTOCENE.	Glacial.
		Subærial.
Cainozoic	INTERMEDIATE.	....
		....
		....
		....
		....
		....
		....
	....	5 Igneous.
Mesozoic	TRIASSIC.	
	PERMIAN?	
	Upper	
	Middle	
		4 Igneous.
	Lower	
....	CARBONIFEROUS.	
	....	3 Igneous
....	DEVONIAN?	
	Upper	....
		Metamorphic 3
....	*Middle*	....
		2 Igneous.
....	*Lower*	....
....		Metamorphic 2
Palæozoic	SILURIAN	
		1 Igneous.
	Lower	
....	CAMBRIAN	....
Eozoic.	2	....
or		
Azoic	1 ARCHÆAN.	Metamorphic 1

[Our un-scientific readers who wish to follow intelligently Dr. Honeyman's interesting series on the Geology of Nova Scotia should possess a copy of Dana's Text-book of Geology.—ED.]

Good works of *Nature*, beautiful, symmetrical, harmonious, and withal perfectly adapted to their uses, are strewn around our daily paths, and are as accessible to the poorest country child as to the millionaire.—*Dawson*.

INSTITUTE OF NATURAL SCIENCE.

The Institute of Natural Science met last night, in the Provincial Museum. Although the weather was unfavorable, there was a somewhat larger attendance than usual. A paper on Fresh Water Sponges, A. H. McKay, B. A., B. Sc., of Pictou, was read before the Society. The Secretary stated that Mr. McKay had done much for the Natural History of our Province. The paper described various species of spongilla, taken from McIntosh's and other lakes, in Earltown. There were exhibited also, under a powerful microscope, exquisitely sculptured specimens of diatoms, silicious spicules of *S. lacustroides*, *Myenia Leidii*, *M. crateriforma* and *M. Everetti*, all neatly got up on slides prepared by Mr. McKay himself. The diatomaceous deposits of these lakes are often several feet thick, and may yet be found to be of some industrial value. An interesting discussion followed, in which Dr. Somers, Messrs. Keating, Denton, and others took part. Prof. Lawson not being present, the meeting adjourned.—*Halifax Morning Chronicle*, 13th May.

NOTES.

BOTANY.

T. J. W. Burgess, M. D., of London, Ontario, has published a very readable account of a "Botanical Holiday in Nova Scotia," in the Botanical Gazette. He has noticed a large number of species not before published.

Dr Burgess is preparing a monograph of the Violaceæ of Canada, and we recommend our Botanists to send him as many species from Nova Scotia in flowers and fruit as can be found. He will be glad to exchange Western plants for such specimens.

Professor John Macoun, F.R.S.C., Ottawa, is about to prepare a monograph of the Canadian Willows. He wants for this purpose specimens of all our willows taken at different seasons to show the flowers, leaves and fruit. This is a most protean and difficult genus of plants, and we are glad to know that a man of the energy and experience of the Professor has at length undertaken it.

Principal McKay, of Pictou, Nova Scotia, is working up the Diatomaceæ of Nova Scotia, and hopes that every reader near a lake may send him a sample of the slime or mud deposits in it. He will give the sender an account of the microscopic organisms determined in it.

Recent discoveries in Botany seem to indicate the continuity of protoplasm from cell to cell by means of delicate threads which traverse channels through the cell wall.

Tischirch regards it as probable that chlorophyll plays "not merely a physical, but also a chemical, part in the process of assimilation," in opposition to Pringsheim, who supposes it to act merely as a light screen or shade to the protoplasmic contents of the cell.

The examinations in the medical courses in England have been much advanced under the new rules, which took effect in January last. These examinations "will have reference to the fundamental facts and laws of the morphology, histology, physiology and life history of plants as illustrated by the following types: Saccharomyces, Protococcus, Mucor, Spirogyna, Chara or Nitella, a Fern, Pinus and an angiospermous flowering plant." This must be the next movement in Nova Scotia.

Botany is required to be taught in

the common schools of Nova Scotia, according to the Provincial course of study, and not a teacher from Grade D to Grade A need have a knowledge of it to take his diploma.

MINERALOGY.

Some perfect garnet crystals from schitose rock on the Stikine River, Alaska, have been received for the museum of the Pictou Academy. The largest is over an inch in diameter, and weighs over an ounce.

In the Mineralogical Magazine W. H. Hudleston advances the theory that diamonds are formed in eruptive rock, and that super-heated steam was the eruptive agent. The carbon is supposed to have been derived from certain carbonaceous shales, which were distilled under great pressure, when the carbon would have "no choice but to assume the crystalline form." He points to the soft earthy breccia made up of fragments of many kinds of rocks in South Africa in which the diamonds have been found in support of his theory.

Mr. W. Cross thinks the topaz may be a sublimation product, especially in certain igneous rocks from Colorado.

A new locality for emeralds has been found in North Carolina. The crystals are pale green, and occur in decomposed black mica associated with quartz, rutile and hiddenite.

During 1883 *sixty millions* of pounds of copper were extracted from the Lake Superior mines.

ORNITHOLOGY.

The Ornithological Club of the Pictou Academy has taken and mounted since its organization in March last over fifty Nova Scotian birds for the Natural History Museum. The Academy is Station No. 420 of the American Ornithological Union.

ENTOMOLOGY.

The butterflies of Amherst, U.S.A., are being described in a popular style in the Bulletin of Massachusetts Natural History, Vol. I., No. 1, issued April 15th, 1884.

ZOOLOGY.

Bonnet beheaded an earth worn eight times, and regeneration followed each time. A worm was cut into fourteen pieces. One piece died, the others reproduced both head and tail.—*Dr. C. Bulon.*

POPULAR SCIENCE.

"The popularization of science is now a leading theme of scientific men," says Mr. Lester F. Ward, of Washington, D.C. "To accomplish this certain branches of science must first become a part of liberal culture. The pursuit of fashion, which is usually regarded as a production solely of evil, may be made an agency of good. If it could become as much of a disgrace to be found ignorant of the flora or fauna of one's native place as it now is to be found ignorant of the rules of etiquette or the contents of the latest new novel, devotees of botany and other branches of natural history would instantly become legion, and the woods and fields would be incessantly scoured for specimens and objects of scientific interest. It should be the acknowledged work of educators to make science fashionable and call to their aid these powerful social sentiments in demanding the recognition of its legitimate claims."

No life
Can be pure in its purpose and
strong in its strife,
And all life not be purer
and stronger thereby.
—*Owen Meredith.*

Literary Notices.

The *Princeton Review* for May is quite up to its usual standard of excellence. Prof. Joseph LeConte, of California, in an intensely interesting article, on "The Psychical Relation of Man to Animals," draws what seems to be the true line of distinction between the intellect of the former, which is able to *create*, and the lower intelligence of the latter, which is only capable of comprehending associations. "Mystical Theism," by the late Prof. M. Stuart Phelps, is a valuable contribution to philosophical literature. The author deprecates the presence of mysticism in philosophy, as appealing to feeling and not to reason. The modern theistic argument to be successful must be scientific and logical.

Other live questions are discussed by eminent authors. No. 2 Nassau St., New York. Three Dollars a year. Fifty cents a number.

Canada at the Great Fisheries Exhibition, London, 1883.—This is a little volume containing extracts from papers read and discussions conducted at the Conference held in London during the Exhibition, and also letters from eminent men of England, expressing in very laudatory terms their high appreciation of the part taken by Canada in the Exhibition, and their great admiration of the zealous and efficient management of this department by the chairman of the committee in charge, Samuel Wilmot, Esq. The superiority of the Canadian exhibit over all others, as was universally admitted, should be a matter of congratulation to all loyal Canadians, and speaks more loudly than words of the efficiency of those to whose enthusiastic labors the same was due. It must be very gratifying to Mr. Wilmot to have his efforts thus appreciated *abroad*, but have he and his associates received at the hands of their *countrymen* that recognition, official or otherwise, which the disinterested nature of their work would seem to demand?

Report of the Entomological Society of Ontario for 1883.—Owing to a stroke of economy, ill timed, perhaps, on the part of Legisture, the present Report comes to us in paper covers. This is to be regretted as the work is worthy of a place on the shelves, not only of the Naturalist, but also of the general reader, and so great would be the convenience made by the expenditure of a few additional dollars in enclosing the volume in cloth binding, that said expenditure would seem to be warranted. The Report contains many interesting and well-illustrated contributions.

No. 3 of the *Bulletins* of the *Natural History Society* of New Brunswick recently came to hand. There is an interesting paper, by G. F. Mathew, M. A., reporting the discovery of a village of the Stone Age, at Bocabec, on Passamaquoddy Bay. Accompanying the description is a map, showing the sites of some thirty huts, with a section and ground plan of one of the most characteristic. The Botanical committee reports the discovery of over sixty species hitherto unrecorded, as occurring in New Brunswick. M. Chamberlain furnishes a list of Mammals of New Brunswick, including forty-three terrestrial and five marine species. The beaver is reported as returning to his old haunts in a few sections abandoned by the lumbermen.

The *American Naturalist*, one of the most valuable Scientific journals published in the world, comes to us for May, loaded with its usual quota of Natural Science News. The leading articles are as follows:—"The Meriquit, *F. Howard*. "The Larval Theory of the Origin of Cellular Tissue," *Alpheus Hyatt*. "The Naturalist Brazillian Expedition, No. III," *Herbert H. Smith*. "The Exhalation of Ozone by Flowering Plants," *Anders*. "The Creodonta," *E. D. Cope*. "A Walk through the Natural History Museum of Florence," *James S. Lippincott*. "Construction of Ancient Terra-Cotta Pitch Pipes and Flageolets." *H. F. Cresson*. Many of these articles are capitally illustrated. The fifty pages of *General Notes* form a most admirable collection of the latest news pithily put.

The *Bulletin* of Torrey Botanical Club for April, opens with a plate of a new species of grass, followed by a neat biographical sketch of Dr. Engelman, with portrait. It also contains a list of New Fungi, by J. B. Ellis and B. M Ewhort, and a collection of interesting original notes on botanical subjects.

Hygienic Physiology, J. Dorman Steele, Ph. D. New York: A. S. Barnes & Co.—This is a revised edition of the author's "Fourteen Weeks in Physiology." The chief improvement made upon that admirable work is the introduction of chapters, showing the deleterious effects of alcohol, tobacco, and other narcotics upon the several organs of the human system.

Palæozoic Fossils, Vol. III., Part I. By T. J. F. Whiteaves, F. G. S., F. R. S. C., etc. Palæontologist and Zoologist of the Canadian Geological Survey.