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THE CHIMNEY SWIFT.

By Charles Macnamara, Arnprior, Ont.

In general the scientific classification of our native birds seems reasonable enough. For instance, any-one can see the mutual relationship of the ducks, geese and swans included in the order Anseres; and the "hen-like" characteristics common to the turkeys, grouse, ptarmigans and quail embraced in the order Gallinae are very evident. And so it is with most of the other orders. Even the Passeres or Perching Birds, which form the largest division of all, comprising all the "smalle fowle that make melodie," diverse as the species are in many respects, are joined, most of them, by the manifest bond of song.

But there is one small order known as the Macrochires, that is calculated to disturb the enquiring layman by the dissimilarity of its species. For when he finds the grotesque whip-poor-will and the eccentric chimney swift classed with the exquisite humming bird, he is apt to harbour a dark suspicion that the systematist, finding at the conclusion of his labours several aberrant and unrelated forms left over, threw them hastily together into one miscellaneous order, and called it Macrochires.

The suspicion, however, would be ill-founded. Different as the birds are in outward seeming, similarities in their anatomy indicate unmistakably a common line of descent. And if food habits afforded any evidence of relationship, it could be pointed out that the humming bird's taste does not differ so much as is generally supposed from that of its kinsfolk, the flycatching swift or whip-poor-will. While popularly believed to live exclusively on nectar, the humming bird in reality consumes large numbers of small insects; and when we see it delicately probing a blossom, it is actually looking as much for little spiders as for flower syrup.

But analogous food habits are no indication whatever of blood relationship, although they often bring about astonishing likeness in external appearance. The mammalian bat, seeking its prey in the air, has developed wings and attained the bird's power of flight. And the warm-blooded, air-breathing whale, making his living in the sea, is always taken by the uninitiated for a fish. But these are extreme cases, and the chimney swift offers a less violent example. This bird is not at all closely related to the swallows (which belong to the order Passeres), but catching its insect food on the wing in sustained flight exactly as they do, it has developed so many of their peculiarities, that not so very long ago ornithologists included it in the swallow family, and it is still very commonly called the chimney "swallow."

Swifts are found all over the world, but compared with many other like divisions of birds, the family is a small one, including only some seventy-five species. They are all noted for their wonderfully rapid flight, whence their popular name. But what distinguishes them most among birds is the remarkable mucus secretion of their salivary glands, used by the majority of them in the construction of their nests. Many species merely glue the nest material together with the secretion, but a genus in the eastern tropics *(Collocalia)* build their nests entirely of this gelatinous substance. These nests, from which the Chinese concoct their famous bird's-nest soup, are such strange productions that it is hard to believe that they are composed solely of an internal secretion of the bird. An ingenious native explanation of their origin, worthy of our own nature-fakirs, is that the birds obtain the mucilaginous shreds by annoying a large holothurian, common along the seashore in the east and known as a sea-slug, until the exasperated creature throws out long slimy strings at them, which they gather up and carry away for their nests. The less picturesque but equally incorrect theory of Western science was that the nests were mostly composed of partially digested seaweed. It is now known, however, that, leaving out of consideration some adventitious dirt, the nests of this genus consist of practically nothing but mucus.

About one-half of the known species of swifts are natives of the New World, but most of them are confined to the southern continent, only four occurring in North America. And of these but one, *Chaetura pelagica*, the familiar chimney swift, makes its summer home in the Eastern United States and Canada, where it breeds from Florida to Labrador.

The chimney swift is essentially a bird of the air and is known to remain for sixteen to eighteen hours continuously on the wing. While its length from beak to end of tail is only 5½ inches, its curved wings measure 12½ inches from tip to tip. These disproportionate dimensions, together with its small head and short neck, give the bird a very peculiar shape in flight. It is sometimes called the "bow-and-arrow bird," but it reminds me most of an anchor with a very short stock. The plumage is slaty black with some dark green reflections, the under parts being somewhat lighter, and there is little difference in the colouration of the two sexes. Its small weak feet are not very efficient grasping organs. Consequently the chimney swift cannot perch like other birds, and is never seen sitting on a branch, or roosting on the wires like the swallows. Except when on its nest, its only resting position is clinging to a vertical surface, in which posture it is supported by

Spined tail feathers of Chimney Swift; natural size.

the curious spined feathers of its tail. Its rapid wing-beats, alternated by short soarings, sometimes with wing elevated over the back, lack the easy grace of the swallow's flight, but it surpasses the latter in speed and nimbleness. It is said sometimes to use its wings alternately, but I have never been able to satisfy myself of this. Its one and only note, which it keeps up very persistently in flight, has been described as a "rolling twitter." Chimney swifts are no songsters, and their dull plumage is not black enough to be dignified; but the quaintness of their crescentic forms darting across the sky with shrill artless twitter, is a delight to every nature lover. And if not beautiful, the swift is certainly very useful, for no bird does more to ward off the insect plague that constantly menaces mankind.

Chimney swifts are for us harbingers of summer rather than of spring. They do not arrive in this district until about the sixth of May, some four weeks after the swallows and martins; and it is only towards the end of June that they begin house-keeping. They are now seen frequently flying in threes, which has caused some writers to surmise that the birds are polygamous. But this is an aspersion on their character. What we are really looking at is that thread-bare theme of the novelist known as the "eternal triangle"—the courtship of a female by two males. To us the uniformity of plumage among the males would seem to preclude the choice of the female being affected by anything analogous to those points considered so extremely important by the young human suitor, such as the fit of his clothes, color of his necktie or the way he brushes his hair; and it would appear that the lady swift must decide for the wooer with the shrillest voice or the freest wing action. But whether her choice be made on these or some more subtle grounds, she soons picks out a mate, and the serious business of nest building commences.

The chimney swift is one of several native birds that have greatly changed their nesting habits since the arrival of white man in America. A few conservatives of the species still observe the primitive practice of building in caves or hollow trees, and occasionally a nest is found attached to the inner wall of a shed or outbuilding; but the great majority of them justify their popular cognomen by nesting in disused chimneys. All the life activities of the swift, except sleeping, egg-laying and hatching, are performed on the wing, and even the twigs of which it builds its nest are gathered in full flight. Hovering a moment over a dead and brittle branch, it drops with elevated wings, and grasping at a dry twig with its claws, breaks it off and flies away with it. (It is stated that it sometimes breaks twigs off with its bill, but I have always seen it use its claws). Eight or ten feet down inside the chimney it glues these twigs to the wall and to one another with its viscous saliva, building them into a shallow semi-circular nest, about 4 inches wide, and projecting about 2½ inches from its support. The natural glue secreted by the chimney swift seems to be practically insoluble. Prolonged soaking of a nest in water causes the adhesive to swell and soften, but does not melt it. Even boiling water fails to liquefy it, and on drying it becomes quite hard again and holds the twigs together as firmly as ever. No doubt this insolubility ensures the nest holding together in wet weather; but it must be said that sometimes the rain softens the attachment to the wall and the weight of the nestlings causes a disastrous fall.

Generally the chimney swift builds in such inaccessible situations that it is not easy to observe their domestic arrangements. One year, however, an unusual chance was offered by a pair who fastened their bracket nest to the inside of a wire fireguard on the hearth of an unoccupied and shuttered summer cottage at Marshall's Bay on Lac des Chats. I had no opportunity of observing the actual building, but the birds seem to have stuck a few twigs here and there on the wires before finally deciding that the right place for the nest was near the top of the guard and about the centre.

The nest, which was a good typical example of chimney swift architecture, was finished about the 25th June, and the last of the four elongate white eggs was laid on the 1st July. Authorities differ as to the incubation period of the chimney swift, some giving 10 to 12 days, while others hold out for 18 days. In this case the young hatched in 16 days, for on the 17th July there were four naked and blind little ones in the nest. They grew at an astonishing rate. By the twenty-fifth of the month, though their eyes were not open yet, they filled the nest to overflowing, and any other young birds not so well fitted to hold on in precarious places, would certainly have fallen out. Only three birds can be seen in the photograph, but the fourth was there, apparently half smothered under the others. Humanly speaking, their position looked fearfully uncomfortable. But we must avoid that deadly sin of science: anthropomorphism. Despite appearances, we may be sure that the swiftlets were as much at ease in their crowded nest as the most cherished human babe in its luxurious cot.

At any rate their appetites were not suffering, for they clamored incessantly for food with an incredible cry more like the metallic rattle of a mechanism out of order than the voice of a living creature. This loud rasping noise is sometimes only too familiar to an unfortunate individual trying to sleep in a room, the chimney of which has been the fatal choice of a pair of swifts. The parents do not hunt all night as sometimes supposed, but as remarked by Mr. A. G. Kingston in the *Ottawa Naturalist* 25 years ago, they take turns at brooding the young, and the roaring of their wings in the chimney as they change places every half hour or so, added to the raucous chattering of the disturbed young, makes sleep quite impossible.

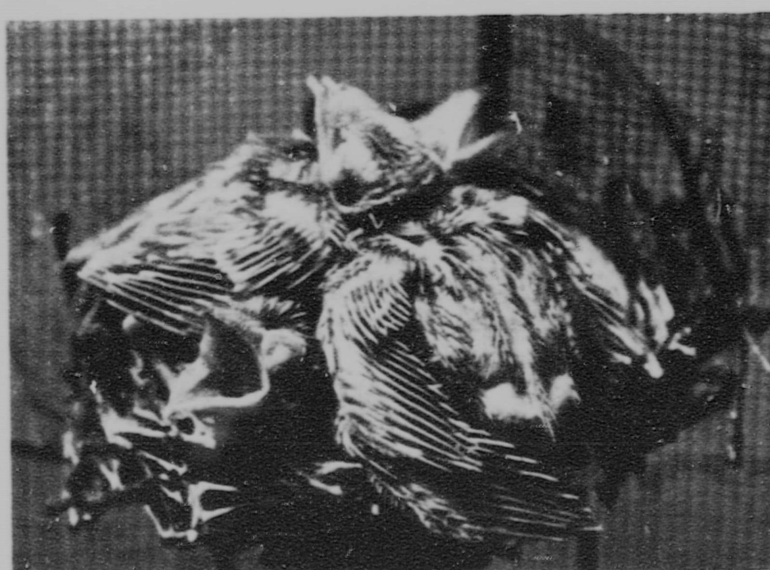
Nest and eggs of Chimney Swift; about natural size.

By the 30th July my young swifts were well feathered, and the spiny quills of the tail had appeared. I did not see them leaving the nest, but some day early in August they must have crawled and fluttered up the dark chimney to the sunshine and the sky, and launched out on fledgling wings, for on the 10th of the month they were gone.

Their departure was acclaimed with unfeeling joy by the family who had been induced—but only under strong protest,—to postpone their usual occupation of the cottage until the young birds were gone. And I regret to say that every year since, ignoring the expostulations of the naturalist anxious to investigate further the home life of the swift, the last callous act of the family in the fall before leaving the cottage, is to place a board over the top of the chimney.

According to Audubon, sometimes thirty or more pairs of swifts used to build in the same hollow tree; but nowadays their habit is solitary, and it is rare to find two nests in the same chimney. Both before and after the breeding season, however, they are essentially gregarious, and gather—sometimes in immense flocks—to pass the night together in some large chimney or similar shelter. On such occasions they may be seen at dusk flying over the chimney in a close swirling cloud, which gradually assumes the shape of a hollow inverted cone; and from the bottom of this living whirlpool, the birds drop continually into the chimney until all are within. Audubon relates that in his time seven or eight thousand swifts congregated thus in a large hollow tree near Louisville, Kentucky. And in his interesting article in the *Ottawa Naturalist* already referred to, Mr. A. G. Kingston tells of the enormous flock that used to gather nightly in a ventilating tower on the Parliament Buildings at Ottawa, the number of birds being estimated by Mr. Kingston at from nine to ten thousand. But these are exceptionally large congregations, attracted together, no doubt, by the size and convenience of the shelters. Usually the flocks number only a few hundreds. The swift population of Arnprior divides up in the fall among several chimneys in the town, the most numerous assemblage—perhaps three or four hundred birds—occupying one of the large chimneys of the Roman Catholic Church, while smaller flocks take refuge in a couple of store chimneys.

If the chimney swifts come later in the spring than the martins and others of the swallow tribe, they make up for it by staying longer in the fall. Most years they are abundant around Arnprior until nearly the middle of September, when they suddenly disappear, the whole flock evidently having flown off to the south altogether. But Mr. Liguori Gormley, who keeps a careful watch on bird doings in this district, informs me that usually, after a period of ten days or so during which not a swift is to be seen anywhere, a few will be observed towards the end of the month flying over the town. These are apparently birds that have nested much farther north, and now, responding to the hereditary impulse of their race, are directing their course like the others for Yucatan or Nicaragua, with that unerring sense of direction, which, although commonly exhibited by many creatures, is a marvel to man because in the course of his evolution, he has largely lost it.



Young Chimney Swifts about one week old; natural size.

THE A B C OF FOSSILS.

By Lancaster D. Burling.

We shall start out with a definition which would do if we were writing a scientific treatise but we shall make every effort to break away from the technical method in what follows. As the definition will show, however, even the technical may be perfectly simple, and might often be more so than it is.

Fossils are direct evidences of life preserved by natural burial in the rocks of the earth's crust.

Fossils therefore represent life and occur in rock, but they need not be the actual remains of plants or animals, and the rock need not be the hard substance which we usually think of when we hear that term. In fact many beds of sand, mud, clay, and marl come within our definition, and all hard rock, with the exception of those that are igneous or volcanic, was once soft. It has been hardened by pressure, heat, and cementation (cement-ation) during the ages that have passed since it was first laid down.

Although a layer of lava (molten rock) flowing into water has been known to trap clams that were crawling over the chilled surface of a previous layer of the same kind of rock, and fossil clam-bakes of this kind have been found on Vancouver Island, for example, fossils are almost always confined to sedimentary rock. By this we mean rock which has been formed from wind-blown dust or sand; from the mud, sand, or gravel in river beds or valleys; from the sediment which falls to the bottom of ponds, lakes, or oceans; from the material piled up or carried by ice rivers, or glaciers; and from deposits for which animals and plants are responsible, for example coral reefs and coal beds. It will easily be seen that sand or mud settling in water would arrange itself in comparatively flat layers, but all sedimentary rocks, whether thrown together by the wind, by a river, by the waves, or by a glacier are piled up in similar layers; they are stratified to use the proper term, and this stratification is often surprisingly regular.

The amount of mud and sand which is being carried by rivers into the ocean, where it must of course all settle, has been computed for the Mississippi, but instead of giving you the number of billion cubic feet a year or the number of hundred million tons a year let us suppose that someone should put in the plant needed to strain this mud and fine sand out of the water before it reaches New Orleans and should send it past that city in canal barges. If these barges were 100 feet long the people in New Orleans would see a barge full of sand pass every 10 seconds or less, and since it would take the river 30 seconds to float a 100 foot barge past a given point the barges would have to pass in bunches of three and there could be no space between the back of one set of three barges and the front of the next. If the man we have imagined were to take care of all of the sand and mud for a year he would have to work day and night, Sundays and holidays, winter and summer, and never allow an inch of space between each set of three barges. If these were to dump their loads in the Gulf of Mexico the sand would settle in piles but the river spreads it out very widely and sends enough material each and every year to spread a one inch carpet over more than 3000 square miles of the gulf's bottom.

This gradual piling-up process, one which takes place on land as well as in the water, affords a continual opportunity for the natural burial of the remains of the animals or plants that die and drop to the bottom. Those remains that do not decay and are preserved, however this may be done, are called fossils. So also are the casts or molds of animals that do decay, their footprints, etc. Whatever the form of the evidence that the animal or plant once lived, it simply must be direct, and whatever the manner in which the burial took place, it must have been by natural means. For example, hard coal, though we know it to be formed of plant remains, is not a fossil, the evidence is indirect; and a dog does not make a fossil, or even start one on the way, when he buries a bone. The latter may be a perfectly natural thing for the dog to do but it does not come within our definition of the term natural, a fact which will be perfectly clear before we are through.

An animal tries to cross a slough and gets mired, or sinks in quicksand, another breaks through the hardened surface of a tar pool and disappears, a jelly-fish is stranded on a tidal flat and the next tide covers it with a layer of sand or mud, an animal walks across some drying mud and the next rain washes sand into its footprints, an insect gets caught in a drop of resin, a mammoth is frozen in the ice in a polar climate, an animal dies on the desert and its whitened bones are covered by the next sand storm, a leaf sinks to the bottom of a pool and is covered with mud, a snail or a clam dies and the shell lies on the bottom of the ocean until it is covered, a coral or a sponge growing on the bottom is smothered by a shifting of the current which covers it with sand.

All of these may, and have for that matter, become fossils; it is only necessary that the mud or the tar or the sand or the resin or the ice shall be preserved (obviously it can not be washed away or destroyed without destroying the fossil), and that the footprint or the shell or the bone or the leaf, or its impression, shall be preserved as well. This is made easy by the hardening of the mud or sand into rock, a process which is sure to follow if the material is given enough time. If the jelly-fish can hold its shape until the layer of mud has hardened, smaller particles will gradually filter into the cavity which it leaves, and these may be different enough from those around it so that when the rock is split apart on this particular layer the shape of the jelly-fish can be seen. The cavity may even become filled with calcite or a similar mineral. The two layers of mud that pressed the upper and under sides of the leaf may show its form and outline even though the leaf decay. On the other hand the shell or the bone, or even the entire body, as in the case of the mammoth, may be preserved as it is, without change. Sometimes, however, only the tube or burrow in which the animal lived is preserved.

Still another way in which fossils may be preserved is best described by supposing that you were to change a picture, a mosaic, which owed its features to the skilfull arrangement of differently colored berries by substituting for each berry a pebble of the same shape, size, and color. You would have changed nothing about the picture but its lasting qualities, you would have made it safe from decay. It is this process in nature but on a very much smaller scale which has given us such fossils as petrified wood. The exchange of particles is here so fine that the smallest details of structure are preserved and may be studied under the microscope.

Now many of the softer rock deposits are exposed at the surface of the earth and man has cultivated the layer of soil immediately above, but they were laid down, formed, ages ago and during the lifetime of the animals and plants whose remains can now be found in them. As we have said these are the real fossils. If a farmer living on such a soil should dig down three or four feet and bury a dog that dog would not become a fossil even though the bones did not decay and were to be dug up thousands of years later together with the remains of the real fossils. It did not get where it is in the ordinary course of events, man put it there. If the real fossils were dog bones it might be difficult to separate the fossil dog bones from the farmer-buried dog bones. But it would be almost impossible to mix a group of animals that had lived on the earth for any great length of time prior to another with that other, so that the fossil expert, for whom the term paleontologist is in common use, could not detect the mixing. If one bone or shell did not give the fact away another would, and even the two sets of dog bones would probably differ from each other, for animals and plants have always changed from age to age. It is this progressive change in time which we call evolution.

If the person who dug up the fossil bones and the farmer-buried dog bones had looked closely he would have seen that the earth around the farmer's dog had been disturbed, that the lines of bedding (stratification) in the nearby rock stopped some distance from the dog and that the earth near it was jumbled together; also that this was not true with regard to the bedding near the fossils. It is this care in collecting and attention to detail which is natural to paleontologists, and which others must make use of when they collect fossils if these are to have any value. Many of the doubtful points in the earth's history, such as whether the human bones which have been found in certain places in our West, or in Argentina, are those of primitive man or those of recent natives were made doubtful by carelessness or lack of observation on the part of the person who first made the discovery.

Nature has been very careful about recording what she has done, however careless she may be in destroying that record, and fossils may be likened to the hieroglyphics which the Egyptians used to carve, in more ways than one. They, the fossils, are Nature's handwriting, her method of labelling the rocks of the earth's crust, and while fossil hieroglyphics are sometimes hard to read, and while they, like those of Egypt, mean little or nothing to the ordinary person, their story is easily read by the man who knows.

Perhaps we can better illustrate the use of fossils by comparing them to the documents placed in the foundation stones of buildings. It is customary to seal up in such stones objects like the daily papers of the date upon which the stone is laid, coins, etc., anything which will indicate to the one who opens the vault, whether this be done in a hundred or a million years, and when every other evidence as to the age of the building may have been lost, the exact period of the earth's history during which the building was erected. Nature has sealed up in rocks of all ages but the oldest, in all but a few varieties, and in nearly all places, articles (fossils) which convey an accurate idea of the relative time at which the different rocky tombs were built, and we are daily becoming more expert in reading the story they tell.

Since fossil experts in all countries are continually at work on these problems, and since an expert in Japan, for example, should know exactly what a

Canadian expert is writing about, we have agreed that all fossils shall have Latin names and that these names shall be used at all times whether the work is written in Japanese or English, or any other language. Since the presence of the same name for two or more things would introduce even worse confusion between the workers in the different countries we have also agreed to give different names to different animals and but one name to similar animals wherever they may be found. This is the only method by which we can speak of or compare accurately and intelligently the fossils occurring in different countries, but since we already know and have described and illustrated several hundred thousand different kinds of fossils some of the names are a little complicated. This explains the unusualness of names such as those in the papers by Whittaker in the April number of the Naturalist and by Lambe and McLearn in the May number. Instead of John Jones, William Jones, and Mary Jones we speak of Jones John, Jones William, and Jones Mary, or to use real fossil names, *Obolus parvus*, *Obolus major*, and *Obolus typus*, putting the important or group name first as do the Chinese. Li Hung Chang is Mr. Li, for example, a change we have to make whenever we get out a directory, a telephone book, or an index, but which the Chinese and the fossil experts do not.

Now let's go back to the farmer's dog. You will remember that we decided that it did not come within the definition and therefore was not a fossil, but supposing the farmer had dug up some fossil bones from another farm, fossils that lived earlier and were therefore really older instead of younger, as the dog was, and buried them in the same way. These would of course be fossils; they were and the fact of their having been moved did not change their nature, but once again, it would take a very expert farmer (a very expert paleontologist in fact) to fool any paleontologist this way. Curiously enough, however, Nature herself has done many things, things which must be included under the head of natural burial, much more confusing than anything we have supposed the farmer to do. Old sea bottoms with their included fossils have been hardened into rock, elevated above the sea, cracked, and the cracks widened by the wear of running water or frost just as such cracks, or joints, are being widened today, and animals living millions of years later have dropped into these cracks and been covered up and preserved. What real difference is there between the farmer-buried dog three or four feet down in a grave beside fossils thousands or millions of years *earlier* than itself and fossils 15 or 20 feet down in a crack beside fossils that much earlier than themselves? None, except that the one is natural, the other artificial, but when we are dealing with fossils this difference is essential. Again, other sea bottoms, hardened into rock and elevated above the sea, are being gradually worn away by agencies which are unable to dissolve the harder included fossils and these weathered-out specimens are being picked up by storms and washed into the ocean to lie on the bottom with animals which have just died. The next layer of mud will cover both, the recent animal and the million year old fossil, and when the new sand has hardened into rock the two forms will be found in the same grave. What real difference is there between the farmer-buried fossils in a grave beside fossils thousands or millions of years *later* than themselves and the nature-buried fossils lying beside fossils fully as much later than themselves? None, except, as in the former case, that one just happened, it was the natural thing, the other was man made and accompanied by an act of will.

If you wonder why paleontologists do not include under the term fossils *any* direct evidence of life preserved in the earth's crust we shall have to say that the evidence of man's interference may be lost and can be hidden, and that his ability to transport animals or plants long distances without leaving any trace as to their source, his conscious interference with the natural course of events, irrespective of the motive, introduces complications which warrant us in putting the limit we have assigned and insisting on natural burial. As a matter of fact we usually confine the term fossils to the evidences of life which have been preserved to us from the prehistoric period, popularly speaking, but the study of fossils and the study of biology merge so closely together that they can not be separated. So do the study of fossil or "prehistoric" man (paleontology) and the study of early or historic man (archaeology).

If you think our illustrations have been too complicated we can only say that Nature has been known to still further confuse the whole problem by turning a whole series of such rocks completely upside down and by scraping half or three-fourths of them away and otherwise disturbing them during the process which has elevated them above the sea. Furthermore we have taken up only a few of the problems which are involved. The animals and plants that peopled the earth at any one time millions of years ago, for example, differed from place to place and from country to country fully as widely as do the animals and plants of today.

The study is so complicated that few geologists care to postpone the beginning of their period of full activity as working geologists by the number of years of preparation required for even an elementary understanding of the story told by the fossils occurring in the rocks which they will study. Those geologists who do wait to become paleontologists stand in the same relation to the geologist that the student of ancient history who can read its picturesque language does to the student of ancient history who can not.

Paleontologists are forced by the broadness of the subject, however, to specialize and usually confine themselves to certain groups of animals or certain groups of rocks, the usual unit of animals being some such group as snails, crabs and crablike animals, corals, or sponges, or even lesser groups. The usual unit in rocks is one covering a period of several million years, a unit which is perhaps best described as a tenth, roughly speaking, of the time since life began to leave its traces in the rock.

If the story of the changes which have taken place in the life on our earth is complicated, so is the story of the changes through which our earth has passed, and the one could not be read without the other. But having observed the order in which the rocks were laid down in favorably located places we are able to study life as it has existed from age to age, and we arrive at evolution, or the idea of a progressive change in life forms as we go from the earlier to the later. Knowing the history of these life changes on our earth and being able to recognize their different stages in the fossils which fill so many of our rocks we are able to trace rock horizons from place to place in unfavorable places, across lakes or seas and underground.

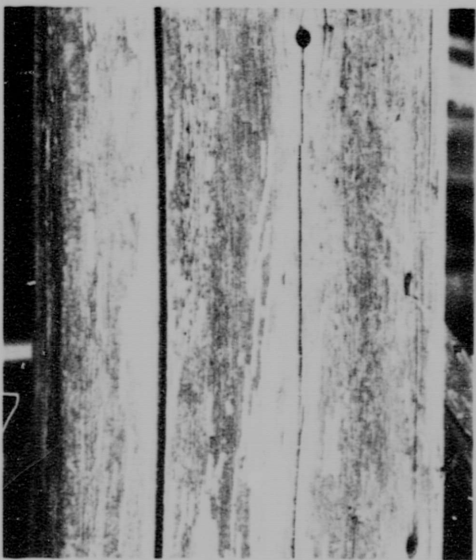
Most of our mineral deposits: coal, iron, oil, salt, etc., etc., occur in such rock horizons, layers whose position in the general order is known, layers which either have fossils peculiar to themselves or lie between layers which do. For example, and space will permit us to give only one: Sands in a certain section of California are found to contain oil. Similar sands show at the surface in many other places, are mapped by the geologists, and wells are bored wherever the sands occur in the hope of striking other oil wells. The sands are thick and boring is expensive, roughly $10,000 for every well sunk, yet the return on the few which reach oil is sufficient to induce private capital to go ahead. A paleontologist is sent out to the field by the official survey and finds that the supposed sand horizon is not one but two, that these are separate and distinct, each with its own particular group of fossils, that they are thousands of feet apart vertically, one being much older than the other, and that only one of them carries oil. He visits the various sand showings, or outcrops as they are called, and maps the distribution of the oil-bearing sand. He is thus able to cut down the absolutely useless drilling, or "wildcatting" as it is called, by one half. If the sand is the oil-carrying one conditions of internal or external structure will affect the location of oil pools but drilling has a chance of success; if it is not the time and money used in drilling are absolutely wasted. A man on a nominal salary, as a part of his regular work, saves the expense of drilling hundreds of useless wells, any one of which would have cost four or five times his salary for a year. The error which private industry is somewhat prone to fall into is the hiring of poorly trained geologists, or men who merely call themselves such, a poor policy in spite of the fact that almost any geologist or pseudo-geologist is better than none. The paleontologist mentioned, for example, and his case is not unusually exceptional, was worth ten times his government salary to any one of the oil companies in California and of course his real value to the country at large, or to the government which employed him, could be measured by the same amount.

For the reader who should question the dispatch of a government geologist for the saving of large sums of money for private industry we shall have to say that the present development of our mineral resources depends in large part upon the far-sightedness and public-spiritedness of private industry; that every dollar which they take out of the ground adds to the sum total of the wealth which we all share, to however small a degree; and that every dollar which they are kept from wasting is left in that same sum total. If they pay it out uselessly it might better be thrown away, because the drilling of the useless well wastes also the time of labor which might have been engaged in productive work. This is elementary economics, not paleontology, but fossils have a dollars and cents value which is sometimes lost sight of. To place it before you in a general statement: Geologists and paleontologists take from mining, second only to agriculture as the leading industry of North America, a large part of its luck or chance, and give it an element of certainty which is of inestimable value to it and to the country at large.

THE ORIGINAL PAPER-MAKERS.

By Charles Macnamara, Arnprior, Ont.

It has often been pointed out that the most indispensible substance in the world for mankind is the green coloring matter of plants known as chlorophyll, for it alone can transform the innutritious solids of the earth and gases of the air into food for us and for the animals we prey upon. But immediately after the food-producing chlorophyll must be ranked as next in importance another vegetable product, cellulose. This material forms the greater part of the rigid skeleton of trees that we call wood, and is the principal constituent of all vegetable fibres, such as cotton, linen and hemp. The timber with which we build and furnish our houses is mostly cellulose, and all our textile fabrics



The light streaks show where V. maculata has been gathering wood fibre.

of vegetable origin are practically pure cellulose. And besides providing mankind with such primative necessities as shelter and clothing, of the countless commodities demanded by modern society, it supplies a large number, ranging from high explosives to artificial silk. But of all these more sophisticated products of cellulose, the most vital to the civilization of to-day is undoubtedly paper.

The supreme importance of paper in the modern world is not always realized. True, the rulers of Germany know now that even a scrap of it may be of the gravest import; but that the whole fabric of civilization is bound together by paper is seldom apprehended. Paper is the guardian of all the records of mankind. We are the heirs of all the ages, because paper has preserved our heritage for us. It is the chief agent in the diffusion of knowledge, without which progress is impossible, and in a thousand unconsidered ways it is woven into the complex of modern culture. And yet, essential as it is to man, it was not he who originally invented it.

Apparently manufactured by the Chinese before the Christian era, paper was not known in the Western World until introduced by the Arabs in the 8th or 9th centuries A.D., when it soon spread over Europe. For hundreds of years it was made principally from linen rags, but with the enormous growth of newspapers in the 19th century this source became inadequate, and about fifty years ago, paper began to be made direct from the cellulose of wood. Now vast forests are felled annually to provide us with our daily portion of more or less reliable news.

But long before the Arabs or the Chinese, countless ages even before our paleolithic grandfather chipped his first stone axe, wasps were making paper from the cellulose fibres of wood by practically the same method as that followed in the latest improved mill of to-day. The whole process of paper manufacture from wood virtually consists in separating the flexible cellulose fibres from the softer parts, dissolving out the gums and oils, eliminating the coloring matter, and lastly, with the addition of size to give the material substance, felting the fibres into sheets. The human manufacturer attains these ends by means of massive machinery and corrosive chemicals. The wasp leaves it to the slow inevitable chemistry of the sun and rain to free the wood of gums and oils, her salivary glands provide the necessary size, and she uses her powerful jaws to loosen and manipulate the fibres.

As is generally known, wasps belong to the Hymenoptera, that large and dominant order that includes, besides our old friends the bees and ants, a large number of more uncommon insects, such as saw-flies, ichneumons, gall-flies, horntails and chalcids. The best paper-makers among the wasps are found in the genus *Vespa* which comprises some forty species distributed the world over, and all social in their habits. Their colonies are composed of queens, males and workers, similar to the communities of their close relations, the social bees and the ants. Some Vespas construct their nests in hollow logs or holes in the ground, and as Nature never wastes any time in works of supererogation, the paper manufactured by these subterranean species, while amply good enough for the protected situation, is but a poor coarse material compared to the strong flexible product of the kinds that suspend their familiar silver-grey nests in trees. Of the seven or eight species of Vespa occurring in the Ottawa district, the commonest bears the sinister name of *Vespa diabolica*; but our largest sized representative of the genus, found right across the continent from Nova Scotia to British Columbia, is *Vespa maculata*, popularly known as the bald-faced hornet, and it may be taken as typical of the most accomplished paper-makers.

V. maculata, which is heavy-bodied for a wasp, wears the traditional wasp livery of buff and black, and owes its popular name to the pale yellow markings on its face. As is usually the case among the social Hymenoptera, the males are larger than the workers, and the queens are larger than the males. The bald-face hornet's chief mental characteristics are a very short temper and an extreme intolerance of strangers near its nest; and it is armed with a powerful sting as many people can feelingly testify. Indeed, a friend who sometimes bears me company on biological expeditions, and who is not at all of a timid disposition, suffers from what may be termed "wasp-shock". Some years ago he incautiously sat down near a hornets' nest, and was severely stung. And now, so far from assisting in the observation of Vespan economy, the very sight of a nest causes him—in the German war-office term—to retire promptly to a prepared position in the rear. Contrasted with the complicated activities of the honey bee or the still more marvellous organization of the ant societies, the life history of a colony of *V. maculata* is comparatively simple. It is rather doubtfully stated that males and workers may sometimes hibernate in the nest, but in general it appears to be only the young fertilized queens that live over winter, sheltering under bark or in rotten logs. On several occasions in the early spring, I have found torpid queens in such situations, but so exposed to the winter cold, that it was a mystery to me how they had survived. Many of the invertebrates—and some of the lower vertebrates too—are extraordinarily resistant to cold. A degree of frost that would be absolutely fatal to a mammal, has no more effect on some insects than to render them temporarily torpid, and on the first rise in temperature, they are as active as ever.

Emerging from her winter quarters with the first fine weather of spring, each queen sets to work to found a colony. She seeks a sound but weather-beaten surface of wood, and working backwards in the direction of the grain, with her strong jaws she gnaws off the outside fibres along a narrow strip, leaving the brighter colored wood exposed beneath. The cedar logs that form the verandah posts of a log-cabin on the shore of the Ottawa at Marshall's Bay, are much frequented by wasps for wood pulp, and some parts of the posts are fairly striped with the numerous tiny furrows left by the workers gathering their supplies. The fibres obtained, she chews them into a paste with a viscid secretion from her salivary glands, and with this material she shapes a tiny globular nest about $1\frac{1}{2}$ inches in diameter, consisting of a couple of layers of paper, enclosing a single horizontal comb of eight or ten cells, opening downward. The nest is often attached to the eaves of a building, but usually it is hung from the branches of a tree at some height from the ground. The favorite habitat appears to be a swamp, possibly because there is less disturbance there from passersby; although no passerby with the slightest knowledge of the habits of *V. maculata* is ever anxious to raise any disturbance with them. The paper is somewhat open in texture, but is remarkably strong and flexible and is quite waterproof. The sheets are formed by the accretion of tiny ribbons of pulp, as can easily be traced in the variegated structure. Some Vespas are said to strengthen their paper with herbaceous filaments gathered from growing plants, but I cannot say that I ever observed this myself. The comb material is much thicker and stiffer than the casing paper, and resembles a rather soft cardboard. The light grey color of the paper blends well with the general tone of the bark, and consequently the nest is not a very conspicuous object in the branches.

When her nest is ready, in each cell of the comb the queen lays an egg which hatches out in a few days. Then for a couple of weeks the devoted mother works early and late to feed her unattractive young grubs—first with regurgitated flower nectar, and later with masticated parts of caterpillars—until they transform into pupæ. The pupal stage is short, and the perfect insects soon emerge. The first broods consist entirely of workers, the queens and males not appearing until towards the end of the season. The young wasps begin work immediately. The beauty of instinct is that it is instinctive. The young workers need no domestic science course to teach them their duties in the nest, but take over the management at once, and the queen, relieved of all housekeeping responsibility, has nothing to do but lay eggs.

The workers, whose numbers are constantly increased by the advent of new broods, now busily forage for supplies and feed the larvæ. And to accommodate the rapidly growing family, they keep tearing away the paper casing inside the nest and adding larger sheets outside. The combs, too, are continually enlarged by the addition of concentric rings of cells, and new layers are built, each suspended by a strong stalk from the layer above; until the nest may consist of a casing of eight or nine sheets of paper a foot or more in diameter, containing half a dozen layers of comb, and sheltering thousands of wasps. Apparently only the younger wasps (distinguished by their smooth perfect wings from the elder workers whose wings have become frayed) are capable of paper-making, they alone secreting the necessary mucus in sufficient quantity. Unlike the slothful drones of the honey bee, the male wasps, who appear with the young queens in the later broods, take an active part in the affairs of the colony, and gather food and care for the young as industriously as their sisters, the professional workers.

Our wasps cannot be accused of food-hoarding. They use their comb as a nursery only, and never lay up supplies in it, like the honey bees. They take no thought for the morrow, but trust to Providence every morning for their daily bread. And a remarkably comprehensive taste in victuals must make it comparatively easy for Providence to cater for them, their bill of fare ranging from flower nectar—that most ethereal of foods—to the gross corruption of rotten fish.

The colony's activities diminish with the cooler weather of autumn, but the routine of the nest continues to the last. Winter always seems to surprise them, as death does mankind; and frozen larvæ and pupæ as well as the bodies of the last few faithful workers are generally to be found in the nests in the winter. Before the cold weather, the young queens mate with the males, presumably from other nests, and crawl away into crevices to wait for the spring. But the courageous tireless paper-makers and foragers, who wrought, single-thoughted for the community's good, from dawn to dark the summer through, all perish with the first severe frost. And now the craven naturalist, who did not dare to approach within many yards of the nest while its fearless defenders were alive, can carry it home in a cheap triumph, as a trophy for his room.

TOURMALINE FROM MACDONALD ISLAND, BAFFIN LAND.

By A. Ledoux, Toronto.

A small crystal of tourmaline was associated with the minerals from Baffin Land described by Prof. T. L. Walker.* This crystal is about six mm. long and four mm. wide. It is dark bottle-green by transmitted light, black by reflected light. The antilogous pole is broken, the other one shows some very fine faces. Following Dana's orientation, they correspond to the upper half forms of: the positive rhombohedron of the first order, p, (10$\bar{1}$1); the negative rhombohedrons of the first order, o, (2$\bar{2}$01) and e, ($\bar{1}$102); the positive scalenohedrons u, (32$\bar{5}$1) and q, (11.5.$\bar{16}$.2). In the vertical zone there are several prisms, the one most developed being a positive trigonal prism of the first order, m, (10$\bar{1}$0); the edges of this prism are replaced by other small prism faces, belonging to the negative trigonal prism of the first order m', ($\bar{1}$010); the hexagonal prism of the second order a, ($\bar{1}$120); the positive ditrigonal prism k, (3$\bar{1}$20). The unequal development of the various prism faces gives to the crystal the appearance of a trigonal prism with rounded edges.

*Minerals from Baffin Land. The Ottawa Naturalist, 1915, p. 63.

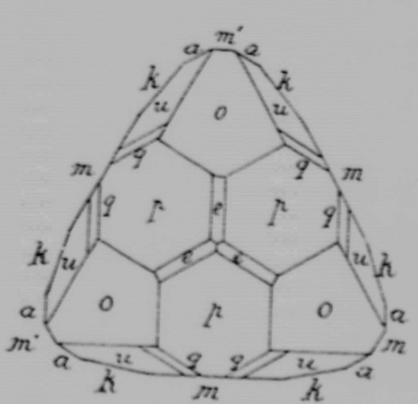


Fig. 1.

A projection of the crystal on the plane 0001 is given on Fig. 1. The measurements were made by a two-circle reflecting goniometer: they are indicated in the following table and may be compared with the calculated angles ϕ and ρ as given by Goldschmidt in his Winkeltabellen.

No.	Letter	Reflections.[1]	Symbols (Miller-Bravais)	Measured		Calculated	
				φ	ρ	φ	ρ
1	k	p	$2\bar{3}10$	8°45′	90°00′	10°53′	90°00′
2	m′	vg	$1\bar{1}00$	0 05	90 00	0 00	90 00
3	a	vg	$2\bar{1}\bar{1}0$	29 59	90 00	30 00	90 00
4	k	p	$3\bar{1}\bar{2}0$	9 57	90 00	10 53	90 00
5	m	g	$10\bar{1}0$	0 00	90 00	0 00	90 00
6	a	vg	$11\bar{2}0$	29 57	90 00	30 00	90 00
7	k	g	$12\bar{3}0$	10 59	90 00	10 53	90 00
8	a	vg	$\bar{1}2\bar{1}0$	29 57	90 00	30 00	90 00
9	m	g	$\bar{1}100$	0 07	90 00	0 00	90 00
10	k	g	$\bar{3}210$	10 57	90 00	10 53	90 00
11	a	vg	$\bar{2}110$	29 56	90 00	30 00	90 00
12	k	g	$\bar{3}120$	10 50	90 00	10 53	90 00
13	m′	vg	$\bar{1}010$	0 02	90 00	0 00	90 00
14	a	vg	$\bar{1}\bar{1}20$	29 58	90 00	30 00	90 00
15	m	g	$0\bar{1}10$	0 01	90 00	0 00	90 00
16	a	vg	$1\bar{2}10$	29 53	90 00	30 00	90 00
17	u	vg	$32\bar{5}1$	23 36	66 21	23 25	66 04
18	u	p	$\bar{5}321$	24 45	67 30	23 25	66 04
19	u	p	$2\bar{5}31$	22 32	66 04	23 25	66 04
20	u	p	$5\bar{2}\bar{3}1$	20 42	68 30	23 25	66 04
21	o	g	$\bar{2}201$	29 58	46 07	30 00	45 47
22	q	f	$11.5.\overline{16}.2$	12 18	50 02	12 13	50 41
23	o	vg	$02\bar{2}1$	29 58	46 18	30 00	45 47
24	p	vg	$10\bar{1}1$	0 07	27 37	0 00	27 20
25	p	vg	$\bar{1}101$	0 16	27 35	0 00	27 20
26	p	vg	$0\bar{1}11$	0 09	27 28	0 00	27 20
27	c	g	$1\bar{1}02$	29 55	14 30	30 00	14 29

[1] vg, very good; g, good; f, fair; p, poor.

It will be noted that the Miller-Bravais symbols used in this table are not the same as those given in the Winkeltabellen for the corresponding angles. This is due to the difference of orientation, Goldschmidt using for the tourmaline an orientation G_2 in which the crystal has been turned 30° around the vertical axis, from Dana's orientation G_1.

If ghkl and g'h'k'l' are the Miller-Bravais symbols of a certain face, respectively in the orientations G_1 and G_2, those symbols are related by the following equations:

$$g = h' - k'$$
$$h = k' - g'$$
$$k = g' - h'$$
$$l = l'$$

Example: g'h'k'l' = 1120

$$g = 1 + 2 = 3$$
$$h = 2 - 1 = 3$$
$$k = 1 - 1 = 0$$
$$l = 0$$
$$ghkl = 3300 = 1100$$

The calculated angles of Goldschmidt are based on Miller's ratio c = 0.4477. The tourmaline from Baffin Land has a slightly different parameter. We may calculate this from the measurements made on the terminal faces, which gave very good or good reflections, by applying the formula:

$$c = \frac{\sqrt{3}}{2} \cdot \frac{l \tan \rho}{\sqrt{g^2 + h^2 + gh}}$$

The results are indicated in the following table:

Number of the face	Letter	Reflections	Symbol	ρ	c.
17	u	vg	$32\bar{5}1$	66° 21'	0.45368
21	o	g	$2\bar{2}01$	46 07	0.45023
23	o	vg	$02\bar{2}1$	46 18	0.45312
24	p	vg	$10\bar{1}1$	27 37	0.45307
25	p	vg	$\bar{1}101$	27 35	0.45243
26	p	vg	$0\bar{1}11$	27 28	0.45019
27	e	g	$1\bar{1}02$	14 30	0.44794

In order to calculate the average value of c, we omit the exceptional value found from the measurements made on face 27 and take the average of the first six values of c. This leads us to:

$$c = 0.45216$$

Such a high value of c indicates that the tourmaline from Baffin Land probably contains ferric oxide Fe_2O_3, a fact that is emphasized by the dark green color. Tourmalines containing alkalis, magnesia or ferrous iron show a vertical parameter smaller than 0.45 and their color is lighter. A chemical analysis could not be performed on account of the small dimensions of the crystal.

The correspondence between the measured angles and the calculated angles of Goldschmidt is as a whole satisfactory; nevertheless some k and u faces gave poor reflections due to natural corrosion figures. In such cases the difference between measured and calculated angles become abnormal.

I am greatly indebted to Professor T. L. Walker and Professor A. L. Parsons for valuable suggestions and assistance in many ways.

SEEDS.

By John R. Dymond, B.A., Seed Analyst,
Dept. of Agriculture, Ottawa.

Seeds may be studied from two points of view. We may study the use which plants make of seeds or the use which man makes of them. From man's point of view there are two uses for seeds (1) as food for himself and animals and (2) for the production of crops. These different points of view are not unrelated and any intelligent discussion of the subject must include a consideration of all three.

Plants are living organisms: their life, like that of all animals, is limited. Some trees live for thousands of years, other for hundreds, but most plants live for only a few years and a very large number grow up from seed, flower, mature their seed and die all in one season. Such plants are called annuals and they are common in parts of the world with severe winters like ours.

One of the uses of the seed to the plant is to preserve its kind through periods of drought, cold or other conditions that would kill the growing plant. In reality the seed is a very small plant carrying with it a supply of food material. In some ways it is comparable with a bird's egg which is packed with food material to provide for the development of the little chick until it is ready to break the shell and pick up its own living. Similarly a supply of food material is stored in the seed for the support of the little plant until it has established its roots in the soil and leaves in the air and is ready to make its own food from the elements drawn from the soil and the air.

A plant or animal is most helpless and most easily destroyed when it is young, but nature has provided that, packed away in a seed, the miniature plant is able to withstand very adverse conditions. It may be subjected for long periods to the low temperatures of winter wtihout injury and the absence of moisture which kills plants only serves to prolong the life of the seed. The ability to withstand such conditions is what makes it possible for many plants to survive in parts of the world where otherwise they would be killed by cold winters or seasons of long continued drought.

This, however, is not the only function of seeds in plant life. A single plant sometimes produces hundreds of thousands of seeds, by means of which it may produce other plants like itself over a wide area of country. Being so well fortified against injury the little plant in the seed is not nearly so easily killed as a little seedling of the same plant would be. It may be carried long distances and lie dormant for a considerable time before starting into life as a new plant. Some (e.g. thistles and dandelions) are provided with downy plumes which enable them to float in the air and to be carried about by wind. The keys of the maple and basswood serve the same purpose. Others have barbed or hooked hairs by which they attach themselves to passing animals (the various burs). Still others are produced in attractive fruits which entice birds and other animals to carry them away as food. Many seeds pass undigested through the digestive tract of animals. Seeds are aften carried long distances by the water in streams, by the wind over the top of snow, in mud attached to the feet of birds and animals and in hundreds of other ways. A plant would not spread its kind over a very wide area if it had to depend on little seedlings being distributed about.

The ability of the seed to maintain its vitality for a number of years is an important factor in the propagation of plants by seeds. It is a common experience for a farmer who has a field containing a certain kind of weed, to seed it to hay or pasture for a number of years, during which he will see few if any of the weeds, and then to plow it up and find plenty of the weeds still in his field. The plants have survived in the field in the form of seeds.

A consideration of these facts makes us realize what an important part seeds play in the plant's struggle to maintain its kind on the earth in competition with other plants and in spite of the adverse conditions which overtake it from time to time.

All plants, however, do not produce seeds. Ferns, mosses, mushrooms and many other plants are propagated by means of spores. Ages ago all plants living on the earth were reproduced by means of spores. The great forests that produced our coal were not made up of seed plants. The advantage which seed plants have over spore plants in the struggle for existence is seen in the fact that to-day seed plants are the dominant ones of the earth.

So far we have considered seeds only from the plant's point of view. Man has found them of great use to him as well. We have already seen that the mother plant stores a great deal of food material in the seed for the use of the little plant during the time it is developing its roots and leaves just as the hen's egg is stored with food for the use of the chick during its development. Just as man finds it convenient to use the food stored in the egg, so immense quantities of human food are secured from the seeds of plants. Wheat, corn, peas, beans and rice are a few of the more important seeds used as food by man.

To a farmer or a gardener seed means anything used to produce a crop. From this point of view the potato tubers put into the ground to produce a crop of potatoes are regarded as seed. In one sense all wheat is made up of the seeds of the wheat plant, but when we speak of seed wheat we mean it is to be sown for the production of a crop.

There are certain qualities which seed must have in order to produce a good crop. In the first place it must be vital, that is, the little plant in the seed must be alive and capable of starting to grow again when given the proper conditions of moisture and temperature. Although the little plant in the seed is able to withstand conditions that would kill the plant that bore it, yet certain conditions will kill it. Extreme heat or cold will injure damp seed more readily than it will seed that is dry. Heat injures seed more readily than cold. Seeds should therefore be stored in a cool, dry place. While some kinds of seed remain vital for a long time, others will live only a year or two. Seeds eighty years old are said to have produced plants, but the stories of wheat taken from the hands of Egyptian mummies, producing plants are not authentic.

Besides being careful to see that grain to be used as seed will grow, it is necessary to examine it to see that it does not contain the seeds of bad weeds. Then, too, we should know its variety. The kinds of wheat grown in Kansas are not suitable for Canadian conditions and so it is with every crop. It is necessary to choose a variety suited to the conditions under which it is to be grown. There are many other points to be taken into consideration in choosing seeds to be used to produce a crop in addition to its vitality, purity and variety.

The seed is therefore to be regarded as a device of the plant for propagating its kind. In fulfilment of this function it is packed by the mother plant with food material for the use of the little seedling. Besides using seeds for the production of crops, man uses them on account of the food material which they contain as food for himself and for his animals.

A LIST OF AMPHIBIANS AND REPTILES OF THE OTTAWA, ONTARIO, DISTRICT.

By Clyde L. Patch.

As a primary reason for publishing this list I submit the following sentence from the check list of the North American amphibians and reptiles recently published by Drs. Stejneger and Barbour: "There still is opportunity for valuable field work to determine the precise distribution of many of our most common species."

Secondarily, I wish to aid in arousing an intelligent interest in these plentiful but, owing to their secretive and nocturnal habits, seldom seen animal forms whose economic value is commonly unappreciated.

The species listed were all observed within a radius of eighteen miles of Ottawa, Ontario, and individuals of each were collected.

Necturus maculosus—Mudpuppy.
Notophalmus v. viridescens—Common Newt, (common).
Ambystoma jeffersonianum—Jefferson Salamander, (most common).
Ambystoma maculatum—Spotted Salamander.
Plethodon cinereus—Red-backed Salamander; Dusky Salamander,—2 color phases, (dusky phase only).
Eurycea bilineata—Two-lined Salamander.
Bufo americanus—American Toad.
Pseudacris triseriata—Swamp Tree-Frog, (common).
Hyla crucifer—Spring-Peeper.
Hyla v. versicolor—Tree Toad.
Rana c. cantabrigensis—Northern Wood-Frog.
Rana catesbiana—Bullfrog.
Rana clamitans—Green Frog.
Rana palustris—Pickerel-Frog, (2 localities only).
Rana pipiens—Leopard-Frog, (most common).
Rana septentrionalis—Mink-Frog, (rare).
Storeria occipito-maculata—Red-bellied Snake.
Thamnophis s. sirtalis—Garter Snake.
Chelydra serpentina—Snapping Turtle.
Chrysemys m. marginata—Western Painted Turtle.

NOTE.—Amphibians and reptiles from any part of Canada will be greatly appreciated if sent to the writer at the Victoria Museum, Ottawa, Ont., Can.

Drawn by C. E. Johnson.

SQUIRRELS AND CHIPMUNKS IN AUTUMN.

In September, one can frequently associate some stroll a-field, with a highly indignant red-squirrel, or chipmunk, resenting intrusion in the midst of gathering his autumn spoils. A number of prettily-striped, ground-dwelling chipmunks, scampering over golden leaves, makes a pleasing picture indeed.

A scene thus enacted, which lingers long in memory, was witnessed, a few miles from the town of Haliburton, in Haliburton District, Ontario.

On a hardwood ridge, bordering a small lake, innumerable chipmunks and red-squirrels, had congregated to gather beech-nuts. Whenever the weather was fine, they were to be seen at all hours of the day, busily scampering over the fallen leaves. Blue jays ate the nuts from the tree-tops, and partridges came often to feed from the ground. A box-trap revealed the presence of the deer or white-footed mouse, which no doubt took nightly interest in the bill-of-fare. White-tailed deer also came quite frequently, in the early morning hours, to lick up the fallen nuts.

Of all these woodfolk, the chipmunks were noisiest, and of particular interest. At intervals throughout the sunny mornings and early afternoons, they would break the silence with a musical outburst, which made the woods fairly ring. This would begin by some individual uttering the familiar "chuck" in rythmical succession. Nearly every chipmunk within hearing distance, mounted stump or log, and responded in unison for several minutes. This outburst would finally subside to two or three individuals; who, failing to receive a response to prolonged "chucks", speedily fell to gathering nuts again. The approach of colder weather, accompanied by a light snowfall in the last week of October, suddenly put an end to their activities.

In Elgin county one September morning, another busy family group was observed, near the edge of a hardwood bush, cutting hickory-nuts from three trees. This group contained six squirrels; five black, and one red. The blacks sometimes came through the tree-tops, and at other times over the ground, and returned by either route. One, which descended with a nut was followed at a distance, and found to have cached five or six hickory-nuts, separately, in the seams of a partially decayed log. I do not remember distinctly whether these were hulled or not. The red-squirrel in this instance worked harmoniously with the blacks. A close watch revealed its hiding place—a hollow elm log close at hand. Within was found about a half-bushel of hickory-nuts, with hulls still on. I am inclined to believe that this was only a temporary store-room; a sort of handy hoarding place, to keep a share from falling to the blacks who had the advantage in numbers.

While watching these active occupations, a racoon emerged from a hole, high up, in an adjacent elm, to sun itself.

An instance where a red-squirrel resented the intrusion of a black-squirrel, occurred in this same bush, on a huge oak. The black-squirrel was first noticed, making its way over the ground to the butt of the tree. He quickly ascended, and, had reached the upper branches, when a wrathful red-squirrel, hitherto unnoticed, sprang to attack. Round and round the trunk they went, the black punished unmercifully. Unable to withstand so furious an onslaught, the black-squirrel rushed to the end of a branch, and, took a wild and flying leap into the next tree. Away he sped through the tree-tops, leaving the victor to hurl his contempt in characteristic red-squirrel fashion. Later he began storing acorns in a hole high up within the oak.

A few notes taken in different localities, furnish an interesting array of autumn food-stuffs.

On Mount Saint Anne, Quebec, in October, a red-squirrel was seen tucking the disk of a mushroom in the forked branch of a tree. Several up the Ottawa river last year, were busily cutting cones from the conifers, in the last week of September. A red-squirrel near St. Thomas, Ontario, had stored a butternut crop within the hollow trunk of the tree which bore them, and a white-footed mouse, in the same locality, had a tiny store of American linden or basswood seeds, under a log, beneath a brush-pile.

C. E. JOHNSON, OTTAWA.

NOTES AND OBSERVATIONS.

ADDITIONS TO THE ODONATA OF THE OTTAWA DISTRICT.—When, in 1908, Dr. E. M. Walker published his paper on the Odonata of the Ottawa district,* he remarked that further investigation would no doubt add other species to the list he was publishing. Indeed, the material he had used for his work had not been the result of systematic collecting, but had been taken largely by entomologists when hunting for insects of other orders.

At Dr. F. Ris's request I paid special attention to the Odonata, and though my collecting was mostly done during holidays I obtained a fairly good number of species, namely 41, amongst which are 12 which are additions to the Ottawa fauna. All the captures were made in the immediate neighborhood of St. Alexander's College, Ironside, Que., which is less than five miles distance from Ottawa.

Another interesting result was the addition of a few records to the fauna of Quebec, namely: *Gomphus spicatus* Hag. and *Libellula luctuosa* Burm.—*Cordulegaster obliquus* Say, *Hagenius brevistylus* Selys and *Boyeria grafiana* Williams, are for the first time definitively recorded from that province, while *Ophiogomphus anomalus* Harv. has not yet been mentioned for Canada, though Dr. E. M. Walker has seen in the Carnegie Museum, Pittsburg, specimens from Lake Nipigon, Ont.† The entire list being of more interest for Quebec, is to be published shortly in the *Naturaliste Canadien*. The additions to the Ottawa fauna are as follows:—

1—*Enallagma antennatum* Say.
2—*Enallagma carunculatum* Morse.
3—*Coenagrion resolutum* Hagen.
4—*Cordulegaster maculatus* Selys.
5—*Cordulegaster obliquus* Say.
6—*Hagenius brevistylus* Selys.
7—*Ophiogomphus anomalus* Harvey.
8—*Gomphus spicatus* Hagen.
9—*Aeshna canadensis* Walker.
10—*Aeshna interupta* Walker.
11—*Aeshna umbrosa* Walker.
12—*Tetragoneura cynosura simulans* Muttowski.

L. M. STOHR, ST. ALEXANDER'S COLLEGE, IRONSIDE, P.Q.

ONE OF NATURE'S WONDERS.—One evening we were sitting on Bon-fire rock, and watching the children at play. All were happy with sail-boats except one little girl, who was watching something on the shore very intently. Jumping up suddenly she came running up to us, calling out in amazement: "Come everybody and see two sticks walking together!"

As we could not resist her eagerness we followed her back indulgently. Following the little pointing finger we too, saw, with no little surprise, two small twigs, evidently fastened together, slowly moving.

Then we turned to our naturalist.

Carefully he explained to both big folks and little folks, that the caddis-fly in its early stage had made itself cosy and secure in a little sack, partly under and partly between, those two little twigs, fastening all firmly together by a secretion stored within itself for that purpose. Then he suggested that the finder, Elsie, should put it in water in a glass jar and watch it closely for a few days to see what would happen. She did not have to watch long, for the next afternoon she called everybody again, exclaiming that something was certainly happening to her specimen. The whole household hurried to the scene. Out between the twigs was emerging a little form, all wrapped in a dainty casing. Then out of this came the adult caddis-fly, which after a few struggles and a few restings, fluttered around the room and then flew gayly out of the window.

M. E. C.

Bide-a-Wee Island,
Upper Blue Sea Lake, Que.
July 31st, 1918.

THE EFFECT OF GOPHER POISON ON GROUSE.—Too often tradition passes current as fact and "what everybody says" is many times accepted without examination or verification, especially when it agrees with conceptions of personal interest. An interesting example of the care that should be used in accepting or acting upon popular report or opinion is given in the report of the Game Branch in the *Public Service Bulletin*, Vol. VI, No. 12, July, 1918, pp. 208-9, published by the Saskatchewan Department of Agriculture.

In this report it appears that the marked scarcity of "Prairie Chicken" (Sharp-tailed Grouse, *Pediocetes phasianellus*) throughout the Prairie Provinces was almost universally attributed by sportsmen and others to the extensive use of strychnine in gopher poisoning. On experimenting with live birds, however, it was discovered that they have such remarkable resistance to this poison that it can no longer be blamed for their destruction.

Two captive "Prairie Chicken" were used for this purpose. Upon the first day these were each fed, in four meals of from 5 to 350 grains each, a total of 1550 grains of wheat poisoned with the usual

*Ott. Nat., Vol. XXII, pp. 16, 49.
†Dr. Walker has kindly permitted me to use this note here.

gopher formula. The next day they were given an unmeasured amount, but all and more than they would eat. The third day, by forced feeding, they were each made to consume 2100 such grains. No ill-effects resulted to either individual. The same grain proved fatal to gophers on the consumption of 15 grains. Thus each bird had in one day eaten enough active poison to kill 140 gophers without perceptibly harmful results.

The formula used was:—

Whole wheat	20 lbs.
Strychnine sulphate	½ oz.
Molasses	1 pt.

Though grouse thus seem practically immune to strychnine, we know that many other species of birds are quite susceptible to it. Seed-eating song birds, Mourning Doves, and even geese are readily poisoned by it, and the greatest care should be used in its distribution. Mr. David Lantz, of the U. S. Biological Survey, remarks that clear grain scattered in the vicinity of water does much to attract and keep birds away from poisoned areas.

It is not necessary, nor at this time, expedient, to use wheat for poisoning purposes. Other grains such as oats, are less attractive to many species of birds, but are quite as effective against gophers. In some of the work of the U.S. Biological Survey in developing control methods against rodents, it was found that where oats were used as a medium for poisoning no Mourning Doves were killed, but on accidental introduction of a small amount of wheat in the mixture, they were poisoned in numbers and dissection showed that they had picked out the wheat while rejecting the other grain.

The use of a cheaper and less valuable grain for this purpose is also to be recommended for other reasons in these days of food stringency. At all times, however, the poison should be used with discretion and care. Small lots of poisoned grain placed at strategic points, such as near or in the mouths of burrows, is quite if not more effective against gophers than is its use in more wide-spread and wasteful manner, and is more economical in material and valuable domestic and wild life.

P. A. TAVERNER.

Ottawa, Sept. 27, 1918.

DIVING HABIT OF THE SPOTTED SANDPIPER.—While on a canoeing trip down the beautiful Restigouche river, in September, Mr. M. B. Dunn and the writer were one morning greatly surprised at the unusual behaviour of a Spotted Sandpiper (*Actitis macularia* Linn.) Our canoe was gliding noiselessly down stream in smooth water about two feet deep and a little sandpiper was skimming over the water ahead of us. It was as peaceful a scene as anyone could wish. Suddenly there was a splash and our little friend had submerged headfirst into the water. In hot pursuit was a hungry pigeon hawk (*Falco columbarius columbarius*) but the dive had saved our comparatively slow-flying little friend. When the sandpiper came up a few feet away from the scene of his hurried dive, the hawk made another swoop at him, but once again and without the least hesitation the little bird went headfirst into the water. Twice baulked by an animated breakfast the hawk gave up the chase, and the day was saved for our little friend.

On the Restigouche these active little hawks are very abundant and undoubtedly exact a heavy toll from the small birds. The Spotted Sandpiper remains abundant, however, and seems to owe its safety to the rather unusual habit of diving.

JOHN D. TOTHILL.

E. H. Forbush, State Ornithologist of the Commonwealth of Massachusetts, is developing a new field of usefulness for his office in the study of bird migration. He gathers current migrational reports from a large list of correspondents and observers throughout New England and adjoining parts of Canada, correlates them and issues mimeographed bulletins to those specially interested. By this means interested investigators have their attention called to passing phenomena while pertinent evidence is fresh in mind and often in time to make additional observations on them while they are still in progress. Bulletin IX, Sept. 16, indicates that there has been a decided decrease in the number of breeding warblers over a large area of New England the past season, certain swamps have been deserted by the Red-winged Blackbirds; Whip-poor-wills have almost disappeared from some localities; Tanagers decreased locally, and House Wrens considerably reduced in number. It would be interesting to see how far these conditions extend and if possible find some explanation for them.

This sample of team work organized and directed by the state is a good example to other public institutions and doubtless will produce important results.

P. A. TAVERNER.

NOTE ON THE BURROWING HABIT OF FROGS.—In June, 1908, while working in the western part of Kansas, I had the opportunity of observing some habits of the Leopard Frog. This particular section is in the semi-arid belt and often, for three or four years at a time, there is not enough rain to thoroughly soak the ground. During these dry periods there is not a frog to be seen except near living water.

At the time above mentioned there had been a prolonged rainy spell and the ground was thoroughly soaked. The frogs appeared in such great numbers, all over the prairie, that one could not drive without running over them. A few days later the rains ceased, and, as the ground began to dry, the frogs disappeared, not to be seen again, at least not in such great numbers, until another wet spell.

At another time, in the eastern part of Wyoming, I had dug one hundred or more post holes about a foot deep, the ground being too dry and hard to dig deeper, when a prolonged rainy spell thoroughly soaked the ground and frogs and toads appeared in great numbers. After the rain ceased, I dug the holes deeper and in the bottom of every hole from two to four frogs and toads had burrowed down as far as the ground had been softened by the rains.

I have often wondered how long frogs can lie dormant or hibernate and if they really remain in this condition between wet seasons, which, in the region referred to, are sometimes several years apart.

Because so many frogs appear during rainy weather and disappear again as the ground gets dry, may be one reason why some people think that frogs rain down.

C. M. STERNBERG.

THE NIGHT HERON AT LONDON, ONT.—On the morning of August 10, 1918, while paddling round the pond, we flushed from the edge, a bird which we took at first glance to be a common bittern, some of which were found almost every morning. Ten minutes later, when the light was that much better, we flushed it again and saw that it was a Night Heron, Black-crowned, of course. To make certain, the bird lit in a tree in plain view and remained for inspection for some minutes. The next morning we had a view that was even better, and saw that the iris was a brilliant orange-red. While flying over the pond, if a Blackbird or Kingbird interfered with it in the least, it gave one of its characteristic notes, which is nearly represented by the syllable *Quah*.

These birds nest in the St. Lawrence valley, and near Ottawa, and in Manitoba, but they are excessively rare in western Ontario. Possibly there is a nesting ground somewhere in the province, but it has not yet been located.

W. E. SAUNDERS, LONDON, ONT.

BOOK NOTICES.

OUR TREES: HOW TO KNOW THEM. By Arthur I. Emerson and Clarence M. Weed. New enlarged edition: Philadelphia and London; J. B. Lippincott Company, 1918.

The new edition (octavo) of this well known work on the trees of North America, is indeed an excellent publication. It is a volume of 295 pages, the type and general get-up being very attractive. The illustrations are very fine and are from photographs taken direct from nature. They have been brought together in such a way that the non-botanical reader can recognize at a glance either the whole tree, or the leaves, flowers, fruits or winter twigs, and thus be able to identify with ease and certainty any unknown tree to which his attention may be called. A single page, in each case, is devoted to a discussion of each tree, opposite to which is given the illustration of the tree or portions thereof. The distingusihing characteristics of the various species are given as well as the more interesting phases of the yearly cycle of each and the special value of each for ornamental planting. Notes on distribution are also included. In all there are 149 illustrations. The price of the volume is $3.50.

BILLY THE BOY NATURALIST. By William Alphonso Murrill.

This interesting book of 252 pages, with 43 illustrations, is a kind of memory ramble taken through the woods for recreation, and is of special interest to children, as it is a true record of how one boy lived. Teachers of nature study will find in it much of interest to read to the children, and to grown-ups it will bring back memories of their own childhood days.

It is an attractively gotten up little volume, printed in such simple language that a child can readily read and understand. The 43 illustrations are all from photographs and illustrate points brought out in the text. The book is published and for sale by the author, whose address is Bronxwood Park, New York City. The price is $1.50.

MURRILL'S AND SACCARDO'S NAMES OF POLYPORES COMPARED. By W. A. Murrill, Assistant Director of the New York Botnical Garden. New York, published by the author, 1918.

The object of this pamphlet of 31 pages is to harmonize the names used by Saccardo and the author for the species of polypores and boletes. Some herbaria use one system of nomenclature and some the other. By consulting this pamphlet one can readily obtain the equivalent of any recognized name in either system. Collectors will also find the pamphlet useful as a check list. The price of the publication is 35 cents

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THE PEACE RIVER DISTRICT, CANADA; ITS RESOURCES AND OPPORTUNITIES. By F. H. Kitto, Natural Resources Intelligence Branch, Department of the Interior, Ottawa, Canada.

This report of 47 pages has recently come to hand. It contains interesting information with regard to climate, soil, agriculture, minerals, game, water powers, transportation and education. A map of the district showing general topography accompanies the report.

In the *Canadian Alpine Journal*,[*] appear three articles of interest to Canadian naturalists. They consist of brief reports on the work done by the Geological Survey of Canada in Jasper Park, Alta., during the summer of 1917, and are in the nature of additions to lists previously published[†] by Standley, Hollister and Riley on the adjoining and Mt. Robson regions. Jasper Park was the scene of some very early collecting and is the type locality for many now well-known species, hence it is of more than passing interest to the naturalist. No visitor to the Park should fail to provide himself with these lists.

THE FLORA OF JASPER PARK, ALBERTA. By J. M. Macoun, pp. 54-61. This is a readable description of the floral conditions surrounding Jasper Station and Mt. Edith Cavell and a generalized account of the species observed. It is of sentimental interest to note that the writer gives a new vernacular name to the Silky Everlasting, *Antennaria media*, calling it in memory of the martyred nurse, the Cavell Everlasting.

ADDENDA TO THE BIRDS OF JASPER PARK, ALBERTA. By P. A. Taverner, pp. 62-69. This contains a short statement of the field work upon which the article is based, followed by an annotated list of species continuing Riley's list from 79 to 108, thus adding thirty species to it besides further notes on nine species already treated by him. The annotations are mostly of a technical nature discussing the supspecific status of the specimens considered.

SOME NOTES ON THE MAMMALS OF JASPER PARK, ALBERTA. By R. M. Anderson, pp. 70-73. This consists of annotations on twenty species of mammals. They are mostly of a technical nature describing the specimens examined, but the collector, Wm. Spreadborough, is freely quoted as to abundance and distribution in the Park.

[*] The Canadian Alpine Journal, Vol. IX, 1918, published by the Alpine Club of Canada, price $1.50, from the Sec.-Treas., S. H. Mitchell, Sidney, Vancouver I., B.C.

[†] Ibid, Special number, 1912.

In the *Condor*, Vol. XX, No. 5, September-October, 1918, are several articles of Canadian interest:—

SOME OCEANIC BIRDS FROM OFF THE COAST OF WASHINGTON AND VANCOUVER ISLAND. By Stanton Warburton, Jr., pp. 178-180. This is an account of a week's trip, June 26-July 3, 1917, to the waters described in the title. It records the occurrence of Tufted Puffin, California Murre, Sooty and Pink-footed Shearwaters, Skua, and Black-footed Albatross. Specimens of most of these were taken and the records placed on firm basis. Whilst the Pink-footed Shearwater does not appear to have been taken within Canadian waters the locality is close enough to be of special interest to Canadian ornithologists.

SOME BIRDS OF ALERT BAY, BRITISH COLUMBIA. By P. A. Taverner, pp. 183-186. This contains a general description of the locality and the conditions under which a week's visit was made to Alert Bay in midsummer, 1917. This is followed by an annotated list of 40 species of birds identified or collected. The annotations discuss plumage sequence, subspecific status and includes some life-history data.

The same author in a short note, p. 187, under head of "Heerman Gull and White Primary Coverts," records an abnormally marked bird from Alert Bay, B.C., similar to those described and figured by Mr. George Willet in the May-June *Condor* of the current year.

The *Ibis*, VI, July 1918, pp. 477-496, contains a bird list of special interest to Prairie ornithologists. Article XXIV, FURTHER NOTES ON BIRDS OBSERVED AT ALIX, BUFFALO LAKE AND RED DEER, IN THE PROVINCE OF ALBERTA, CANADA, IN 1915-1916. By Chas. B. Horsbrough, Canadian Army Medical Corps, C.E.F. These notes are additional to a similar paper (*Ibis*, 1915, pp. 670-689) and include extensive annotations on 96 species, containing some important records and a large amount of life-history, distributional and migration data.