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THE OTTAWA NATURALIST

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NOTES ON THE GEOLOGY AND MINERAL RESOURCES OF TRINIDAD AND BARBADOS, B. W. ISLANDS.

By R. W. Ells, LL.D., Etc.

Summary of paper read before Royal Society of Canada, May, 1907.

The islands of Trinidad and Barbados are among the most southerly of the Windward island group of the West Indies. The former lies a few miles off the north coast of South America, opposite the mouths of the Orinoco river, with an area of 1,750 square miles, and a population of about 255,000; the latter, about 200 miles to the north-east, with an area of 166 square miles, and, with a population of rather more than 1,200 persons to the square mile, can rightly be considered the most densely populated country in the world in so far as now known.

The geology of both these islands is quite simple. In Trinidad, the northern portion from the passage separating the north-west corner from Venezuela, known as the Bocas, to the cape at the north-east extremity, is occupied by a range of hills with elevations rising in places to more than 3,000 feet, composed of slaty and schistose rocks with occasionally areas of limestone. The schist is cut by veins of quartz, generally of small size, in which traces of gold are found, while the presence of iron has also been recognized at several points. These schists are the oldest rocks in the island, and resemble the lower Cambrian of Canada in many respects.

South of this and comprising by far the greater part of the island the rocks are much more recent, consisting for the most part of shales and sandstones of Tertiary age, with possibly small areas of underlying Cretaceous, especially along the southern flank of the mountain range. These Tertiary rocks comprise large areas of oil-bearing sandstone, and the formation as a whole, is thrown into a series of folds or anticlines, of which four principal ones have been recognized as extending in a general east and west direction across the southern part of the island, with several secondary ones. Along the courses of all these, oil-springs, outflows of asphalt or thickened petroleum and occurrences of natural gas are frequently seen, with mud volcanoes which indicate the escape of the gas in large quantity.

The most northerly of these anticlines, yet definitely recognized, comes to the west coast at the town of San Fernando where a hill rises to a height of about 600 feet above the sea. On both sides the oil-bearing sandstones are exposed dipping generally to north and south and in the back streets of the town itself outflows of asphalt are seen which represent the crude petroleum which has been deprived of its volatile matter through oxydation. This oil has originally been derived from the oil-sands in the vicinity, some portions of the formation being fairly saturated with it. This anticline, like the others, extends across the island to the east coast.

The second anticline, going south, extends from the west coast at Point La Brea, about 15 miles west of San Fernando. On this is situated the famous Pitch lake, which is one of the most wonderful features of this island. Oil is also issuing from the rocks along the course of the anticline at a number of points, and deposits of asphalt are found at intervals. An old oil well near the lake, though nearly choked up, is still discharging petroleum by simple overflow.

The third anticline extends from near Guaypo point, about five miles south of the La Brea Pitch lake, eastward to the east coast, and is well defined at a number of places. At the outcrops on the west coast the strata are vertical for several hundred yards and the blackish-grey sandstone is, in places, saturated with oil which oozes out and forms a scum along the beach, while heavy outflows of the ashpalt are seen both along the shore and at many points inland along the course of the anticline. Near the west end a very strong English company, comprising Lord Dundonald and others, has recently begun a systematic series of borings for oil with every prospect of success. At or near the village of Fyzabad, about 12 miles inland, there are other large outflows of asphalt associated with thick black oil which forms small pools, the surface over a considerable area being covered with the oil and asphalt.

The fourth and most southerly anticline keeps along the south coast, terminating westward near the south-west corner at Icacos point and sometimes extending out to sea for short distances. It comes to the south-east corner of the island at Guayaguayare near Point Galiota. At the western end pits sunk for a few feet through the overlying sand into the oil-bearing sandstone soon become partly filled with oil which is derived from the sandstone formation below. This has not yet been tested by boring, but the indications for finding oil in this place are undoubtedly very favourable. All along the exposed course of this anticline to the eastern point similar occurrences of oil are seen and mud volcanoes are observed which indicate the explosive nature of the contained gas in subterranean reservoirs, with oil springs at intervals and saturated layers of sandstone. At the eastern portion a number of borings have been made to depths of 800 to 1,000 feet, in nearly every one oil being found sometimes in large quantity. This field is now being exploited rapidly with every appearance of success.

Borings along the east coast at several points have also disclosed the fact that oil will be found in economic quantities at widely separated locations, one of these near the beach on the east coast, merely a trial hole, apparently having yielded according to the Government report at the rate of 60 to 70 barrels per day. More recent borings at Guayaguayare have made returns of oil at the rate of 12 to 16 barrels per hour. None of these wells are gushers, but the oil rises to near the surface and can be easily pumped.

These borings, made at somewhat widely separated points in the southern portion of the island, point conclusively to the assumption that oil fields of very great economic value exist in this area, and require only the judicious expenditure of capital to ensure satisfactory returns. In geological horizon the rocks are similar to those of the celebrated oil-wells of Baku in southern Russia and of Texas and California in the United States. They are of somewhat higher horizon than those of the Florence field in Colorado, which are apparently in Cretaceous rocks, but very similar to those of Burmah in the East Indies. They differ markedly from those of Canada and of the eastern United States, in which countries the oil is obtained from formations ranging downward from the Devonian to the Trenton limestone.

The Pitch lake of Trinidad, to which reference is often made, is a feature of great scientific interest. It has been visited by several scientists and various opinions have been expressed as to its origin, some contending that the surface especially in its central portion is soft and the asphalt hot, connecting its presence with volcanic phenomena. In point of fact the surface of the lake is hard and smooth, except for the presence of numerous fissures which traverse it, and are filled with water, and for the growth of trees which have evidently taken root in drifted areas of sand along such fissure lines in which seeds from the surrounding forest have lodged and taken root.

The lake itself is a vast body of asphalt, brownish-black in colour, with an area of nearly 140 acres. It is located near the west coast at Point La Brea at an elevation of about 100 feet above the sea level and at a distance of nearly one mile from the shore. In outline it is roughly circular, is deepest near the centre where a boring of 175 feet failed to touch the bottom, and gradually shoals towards the shores, having the character of a deep circular basin. By some it is supposed to owe its presence to the action of a mud volcano, and the crater-like aspect of the lake itself supports this view. By others the opinion is expressed that it occupies the denuded crest of the La Brea anticline at this point and that the crude petroleum has gradually flowed into the denuded area, from the surrounding strata of oil-bearing sandstone, the volatile matter has been oxydized, and the remaining asphalt now forms the lake. In the one case the denudation is supposed to be caused by the agency of a gas explosion as with ordinary mud volcanoes, in the other case it would probably be caused by atmospheric agencies since it cannot be supposed that glacial action was ever experienced in these southern islands. The origin of the pitch or asphalt is without doubt due to the oxydation of the crude petroleum which flowed into the present depression from the surrounding rocks.

It was long supposed that the level of the lake was constant, but when mining began on a large scale a careful series of levels and other measurements was commenced. In this way it was ascertained that in the 14 years during which mining has been vigorously carried on the level of the surface has been lowered seven feet, or at the rate of six inches per year. In this period it is estimated that about 1,500,000 tons of the asphalt has been extracted and shipped.

The surface is hard, and the asphalt is mined with an ordinary pickaxe, the mineral breaking out readily with a sharp line of fracture. It is loaded into tram cars and either sent to the shipping point by a line of cable tram to the pier, or hauled along a second tram line by mules to the shipping point or to the boiling works where it is purified by the removal of the contained water and of a certain amount of both organic and inorganic impurity. The digging is made to a depth of one to two feet, when the tram line is moved along the surface, but in a few weeks the depression thus made is filled and the surface is again level. There appears to be a certain slow movement going on which affects the greater part of the mass, and lines of flowage are seen in the apparently solid mineral as if the whole mass were in motion from the surface downward. This movement is apparently due to convection currents, which may be caused by the displacement of the whole mass through mining or possibly to the still further and continued inflow of semi-liquid pitch from the sides or bottom of the lake basin.

From the original lake basin immense quantities of the asphalt have been discharged seaward to the shore where along the beach it now extends for more than a mile. This beach asphalt contains a somewhat larger percentage of impurity than that of the lake, since it has evidently picked up certain inorganic, as well as organic, substances in its passage from the lake to the sea, the movement having apparently been made when the mineral was in a somewhat plastic condition. In composition the asphalt contains about 40 to 50 per cent. of bitumen, about 30 per cent. of water, the remainder consisting of the impurities mentioned.

The mines of manjak, located near San Fernando, are also exceedingly interesting. The mineral is also an altered petroleum, and now occurs in fissures which traverse the shales and sandstone of the oil-bearing series in the same way as the albertite mines in New Brunswick have been formed. Their position is near the crest of an anticline, and the fissures have been formed in the period of disturbance or crushing by which the anticlinal folds were produced.

The mineral manjak is a very pure variety of asphalt, carrying from 90 to 95 per cent. of bitumen. A certain amount of impurity is found in the form of clay particles, evidently detached from the sides of the fissures in the process of vein formation. It is jet black, glossy, and brittle, and can be lighted in the flame of a match, dropping like sealing wax and taking readily the impression of a seal. In this respect it differs somewhat from New Brunswick albertite which does not fuse readily, but splinters on the application of heat. Manjak is largely used in the manufacture of high grade black varnishes, insulating paints for electric conductors, waterproof paints, etc. The veins vary greatly in size, the principal one worked having increased from a width of about seven feet at the surface to over 30 feet at a depth of 200 feet. Much of the mineral in the upper 100 feet is what is known as columnar, as if the vein matter had been shattered by pressure, but at lower depths the massive form comes in and forms the greater portion of the deposit. In its conchoidal fracture it resembles strongly the albertite of New Brunswick as also in general aspect. The difference in the mineral is apparently due to metamorphism on the part of the latter, which occurs in Devonian rocks while the manjak is found, both in Trinidad and Barbados in the soft Tertiary clays and is comparatively unaltered from its pitch condition, in this respect presenting analogies to anthracite and lignite in the coal series. The limit of the veins in depth has not been ascertained at any one point; with one exception in Barbados where in a shaft at a depth of 150 feet the manjak became soft and soon passed into a thick, asphaltic oil which could be removed by bailing. The Barbados mineral is somewhat purer and apparently softer than that of Trinidad and commands a higher price in the market, some portions of the output realizing as much as $75 to $90 per ton in the English market. It will be seen, therefore, that this mineral has a high economic value, and with the increase in the demand should form a very important article of commerce. The albertite of New Brunswick, of which some 250,000 tons were mined before the vein matter was exhausted, was used largely for mixing with ordinary bituminous coals in the manufacture of gas, possessing the property of keeping the production at a high standard.

It can be readily seen, therefore, that the island of Trinidad possesses great resources in the matter of asphalt, manjak and petroleum, which are now coming into prominence and will undoubtedly, in a few years, become a great source of wealth to the investors and of revenue to the government, since the development work already done is most encouraging.

The crystalline schists of the northern range are also well worthy of careful exploitation. The indications of gold in the numerous quartz veins already observed, and of iron ores of several kinds are important, but so far but little attention has been directed to this formation. Nowhere in this island was any indication of volcanic rocks observed either in loose pieces or in actual outcrops.

In Barbados the geological formations are somewhat different. Of the 166 square miles in the area, six-sevenths are occupied by coral limestone, which doubtless at some time formed a complete capping over the whole island. This coral formation reached to the highest points of the island, or about 1,100 feet above the sea, though to the ordinary observer or visitor the island is usually regarded as of but small elevation. The remaining seventh in the north-eastern portion shews a series of Tertiary sediments which are almost identical with those seen in Trinidad, and like that island, contain petroleum and manjak in large quantities. They have been exposed by the denudation of the overlying coral, which presents bold escarpments facing to the east. Between the Tertiary rocks and the coral is a considerable thickness of earths and clay deposits with an aggregate thickness of nearly 300 feet, which, with the overlying coral formation, are quite undisturbed.

The Tertiary oil-bearing sandstone and shale are more highly disturbed than those of Trinidad, the anticlines being sharper and the strata in places overturned for short distances. As in Trinidad, boring for oil has been carried on for some years as well as mining for manjak, and some fifteen holes have been sunk, several of which have been carried to depths of over 1,000 feet. In most of these oil has been found in some quantity and a pipeline and refinery were erected several years ago, the oil being pumped from the wells to the height of land whence it descended by gravity to the refining works near the city of Bridgetown. In certain cases the location of the borings was unsuitable, the sediments being too greatly disturbed to be largely productive of oil, so that the yield of petroleum in economic quantity has not been satisfactory; but at other places the conditions are more favourable, the strata being more regular and less broken, while beneath the coral and clay formations, the latter being known under the name of "Oceanic beds," the oil-bearing Tertiary probably occurs throughout the whole extent of the island. Here also, owing to the covering of impervious clays, the possibility of finding oil in paying quantity should be more favourable than in those portions where the clay and coral formations have been removed, as in the north-eastern portion. The thickness of the coral formation varies from a few feet only to 200 feet, and in some places possibly 250 feet, and the Tertiary rocks are sometimes seen owing to the denudation of the coral, more especially in the southern and northern portions of the island. The judicious expenditure of a certain amount of capital by boring in this coral-capped area should be carefully considered.

In the Oceanic, or clay and earthy deposits, are large beds of infusorial earths, often beautifully white and resembling the infusorial earth obtained from the beds of lakes in eastern Canada. The microscopic examination of the contained foraminifera, however, shews that the forms are of deep sea water types, instead of fresh water origin, as is the case in the northern lake deposits. These infusorial earths should, at some time, be of economic importance. No trace of volcanic rocks are seen in this island.

The manjak deposits of Barbados occur in true fissure veins as in Trinidad, the fissures undoubtedly being formed during the general period of upheaval which affected the Tertiary oil-bearing sands. The origin of this mineral is clearly seen in the case of the shaft referred to where the manjak passed down at 150 feet into petroleum. The inference is that this petroleum has flowed into the fissures thus formed, either from the sides or bottom, from the oil-sands which have been thus traversed; the volatile matters have been largely removed by oxydation, and the asphaltic portion has remained as a vein filling. Apparently similar conditions affected the albertite deposits of New Brunswick.

DESCRIPTION OF A CANADIAN SPECIES OF PELTOCERAS.

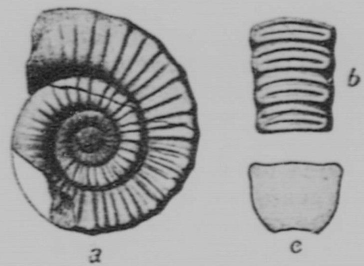
BY J. F. WHITEAVES.

The genus *Peltoceras* was constituted by Dr. Waagen for the reception of certain Jurassic Ammonites from Europe and India, that are most closely allied to *Aspidoceras* and *Perisphinctes*. A "short diagnosis" of this genus was published in November, 1871, in the fourth part of the fourth volume of the Records of the Geological Survey of India. And, under the auspices of that Survey, a much fuller description of the generic characters of *Peltoceras* was published in 1875, in the first volume of the "Jurassic Fauna of Kutch." In the latter publication Dr. Waagen makes the following remarks: "Most essential for the generic determination of the shells I place under the name of *Peltoceras* is the form of the earlier stages of growth, which is characteristic to a high degree, and varies but very little in most of the species. The strong, sharp, mostly dichotome, but sometimes also undivided, ribs, which cover the inner whorls of those Ammonites, cannot be easily mistaken, and serve well to recognize the genus, even in specimens where other characteristics are not observable. The whorls are always very little embracing, and the transversal section of the latter somewhat rectangular." The genus is divided into three sections, viz.: (1) The group of *Ammonites annularis*, Reinecke; (2) the group of *A. Eugenii*, Raspail; and (3) the group of *A. athleta*, Phillips.

In the summer season of 1906, Mr. D. B. Dowling found a small Ammonite, which seems to the writer to belong to the genus *Peltoceras* and to the group of *P. athleta*, in rocks of mesozoic and presumably of Jurassic age, on the Red Deer River, Alberta, at the Rocky Mountain Park. This little Ammonite is not more than an inch and a quarter in its maximum diameter, and represents only the early stage of growth of the shell, but that, as Dr. Waagen states, is highly characteristic in the genus *Peltoceras*. The sutures of its septa are not preserved, but the outline of its transverse section, and its surface ornamentation, are essentially similar, in a general way, to those of the corresponding stage of growth of *P. athleta*, as figured by d'Orbigny, under the name *Ammonites athleta*, on Plates 163 and 164 of the "Atlas" to the first volume of the "Terrains Jurassiques." This Canadian *Peltoceras*, however, seems to be specifically distinct from

P. athleta and other known species of the genus, and may be provisionally named and described as follows:—

PELTOCERAS OCCIDENTALE, sp. nov.



Peltoceras occidentale; *a*, side view of the only specimen collected; *b*, portion of venter of the same, showing four primary bifurcating ribs, alternating with four secondary simple ones; *c*, outline of transverse section of the outer volution of the same, near the aperture. All the figures of the natural size.

Shell widely but very shallowly umbilicated on both sides, the umbilicus occupying fully two-thirds of the entire diameter.

Whorls slender, increasing very slowly in size, in close contact throughout, but without embracing, flattened and widest on the venter (as shown in figure *c*) angulated at its junction with each side, and narrowing convexly and somewhat obliquely inward, to the rather narrow dorsum, which is impressed longitudinally by a very shallow furrow of contact.

Test unknown; surface of the cast of the interior marked with numerous, nearly straight transverse ribs. On each of the sides all the ribs are simple and unbranched (as shown in figure *a*) which represents one of the sides. But, at the ventrolateral angulation on each side of the outer whorl, each primary rib swells into a comparatively large, circular and flattened tubercle, then bifurcates (as represented in figure *b*) or trifurcates in passing over the venter, and finally coalesces with a similar tubercle on the ventrolateral angulation of the other side. The secondary ribs are as long as the primaries, but the former are neither tuberculated on the outer margin of the outer whorl, nor divided on the venter, though they are not infrequently interrupted in or by the close proximity of a tubercle on one of the alternating primaries.

Sutural line unknown.

Maximum diameter of the only specimen known to the writer, thirty millimeters; that of the umbilicus, from suture to suture, twenty-one millimeters.

Red Deer River, Alberta, at Rocky Mountain Park, D. B. Dowling, 1906; the small specimen figured, which shows the characters of three of the outer whorls, the nuclear ones not being preserved.

In the correspondingly early stage of growth of *Peltoceras athleta*, as figured by d'Orbigny, the primary ribs have not begun to develop well defined tubercles, and they bifurcate from near the middle of each side of the outer volution.

Dr. Waagen says that a specimen of *Peltoceras annulare* or *athleta* has been found in the "vicinity of Mombas, equatorial Africa," so that the genus is now known to be represented in the mesozoic rocks of Europe, Asia, Africa and North America.

As *Peltoceras* is regarded as an exclusively Jurassic genus, it would seem most probable that the rocks at Rocky Mountain Park from which the type of C. *occidentale* was collected, are of Jurassic age. On purely palæontological grounds, also, it would seem highly likely that those presumably Jurassic rocks in Alberta which hold *P. occidentale* are of about the same age as the coarse grits from the Crow's Nest coal fields near Fernie, B.C., which hold *Cardioceras Canadense*, and as those Jurassic rocks in the Black Hills of Dakota which hold *C. cordiforme*. In a Bulletin of the American Museum of Natural History, New York, published on December 17th, 1906, Professors Whitfield and Hovey have shown that *C. cordiforme* is a very variable species, especially in the adult state, and it is just possible that *C. Canadense* may prove to be only a local variety of that species. However that may be, it is abundantly clear that both *C. cordiforme* and *C. Canadense* are very closely allied to the British and European *C. cordatum*.

OTTAWA, July 12th, 1907.

THE SECOND CHAPTER IN THE STORY OF THE MIGRATION OF BIRDS OF THE PAST SPRING.

BY G. EIFRIG

In the May number of the "Naturalist" the present writer published an account of the remarkably early appearance of some of the bird migrants in this vicinity, when there was nothing here whatever to tempt them to come earlier, together with the pr[illegible]ble reasons for this phenomenon. Appended was a list of 2[illegible] species, that were the firstcomers this spring. That was, if you please, the *first* chapter in the story of the past season's migration. It was an auspicious and promising looking one. However, the end in the migration did not bear out the promises of its beginning. The second chapter is an unsatisfactory, yes, even a melancholy and sad one.

When May, the principal migration month, came, it came not as usual, smiling, laden with fresh green leaves and blossoms; but darksome, gloomy, with lack of sunshine and warmth. The violent snowstorm on May 4th, leaving about six inches of snow on the ground, was but a foretaste of what was to come. Such extraordinarily cold weather had not been recorded in May for many years. There were heavy frosts at night, and occasional slight snow flurries as late as the 28th. Nor were we here the only sufferers from this winter weather in May. It is recorded as the coldest May for 35 years at Washington, and at Detroit, Fort Wayne, Ind.; yes, even at St. Louis, where the writer had occasion to go in May, conditions were the same. To see furs worn in May is certainly a novel sight for St. Louis, but it was a very common one this year.

The effect of this on plant and animal life was naturally a very marked one. Vegetation practically remained at a standstill throughout May. The buds that were on the trees in the beginning of May remained unopened until almost the end; the trees were nearly bare. Insect life was correspondingly kept back. Mosquitos, flies, etc., were few and far between, also the numerous small insects frequenting the newly opened blossoms and leaves. And the effect of all this on birds was simply disastrous. The arrival of most species was very considerably delayed, as the list given below shows. For instance, the chimney swift, 1906, April 30; 1907, May 10; house wren, May 2–9; spotted sandpiper, May 2–19; yellow warbler, May 4–13; bobolink, May 5–18; black-throated green warbler, May 7–16; parula warbler, May 7–15. The least flycatcher, whose note *chebec*, from which it also gets a name, can be heard in trees of our streets as soon as it arrives, came in 1906, May 11th—which already was later than usual—but this year it turned up only on May 15th, and then one or two half-hearted specimens only. The tiny hummingbird, due here between May 10th and 15th, was this year not recorded by the writer before May 30th. The wood pewee, with the chebec, a common breeder in our city shade trees, who also unmistakably betrays his presence as soon as here, came this year only on June 1st, other years it is here May 17th. The last regular migrant in these parts, who comes here in numbers, and whose presence can not be overlooked owing to his unique call or song, is the blackpoll warbler. Their advance guard usually arrives about May 20th but this year not before the 31st. Thus the uncongenial climatic conditions delayed these 11 species from four to seventeen days, an average of 10 5-11 days. Other years the days about May 23rd produce the largest waves of migrants, but this year the first large wave struck the gardens along our city limits on May 29th, thus showing a delay, if looked at from this standpoint, of six days.

Another notable factor is the decrease in numbers. The first arrivals of the above mentioned species were mostly single birds or at least in lesser numbers than in other years. And, whereas, in other years, the species given above become common in most cases two or three days after their advance guard has arrived, this was not the case during the last cold May. The first comers were, in many instances, the sole representatives of their species, in fact, some were seen and then not again for many days. Of course, in most cases, the normal number was reached by late and numerous accretions, but in many instances the usual abundance was never reached. This holds good in the case of the chimney swift, brown thrushes, whippoorwill, hummingbird, scarlet tanager, and very noticeably so in the case of the blackpoll warbler. Of course, there were nevertheless large waves of warblers in certain restricted localities during the last few days in May, and some who happened to get amongst them would say that they had never seen so many birds, etc., but I am convinced that there is not nearly the usual number of warblers, especially here, this summer. So, admitting the great mortality which decimated the ranks of the warblers fearfully after they did come here, also the possibility of many having retraced their steps for a little distance to the south—that the tree swallows did this earlier in the season, I am almost positive—still the fact cannot well be contraverted that the exceptional cold in May did decrease the numbers of migrants to some extent, in many cases seriously so.

But nature often likes to upset pet theories, often very elaborate ones, so there are also some exceptions to these two stated effects of the coldness in May. Thus, for the scarlet tanager, I have a record of two days earlier than last year; the nighthawk came on the 16th as usual as though there was no cold weather and dearth of insects. Again, the spotted sandpiper was unusually abundant in June. The purple martin seemed more numerous than usual for a while, the olive-backed thrush was decidedly commoner than usual, and on May 19th, Mr. A. Kingston found the black-throated blue warbler exceedingly numerous in Dow's Swamp, their numbers equaling those of all other birds combined, while a half dozen or so, at most, is the usual number seen together when the migration is normal and at its height. The cedarbird, usually here in March, was not seen by the writer till June 7th, but was in its usual abundance and superabundance in July. And it is just these variations from one year to another, these continual apparent anomalies and surprises that make the work of the ornithologist so interesting and fascinating.

And now comes the harrowing part of the story. The coldness of the season caused a deplorable mortality among birds, especially warblers and swallows. Vegetation was, as already stated, at a standstill for weeks; therefore, the insects, plant lice, etc., that abound on the leaves of trees; moths, gnats, etc., that usually fly about at that time, were absent. On that account there was great suffering among the insect-eating birds that had come, most acute among warblers. They could be seen everywhere, apparently in great distress, wings half opened, often too weak to fly, looking for morsels of food in places where they are otherwise not seen. I saw Canadian and Blackburnian warblers searching for food among tin cans and refuse heaps. on roadsides, unable to fly. A beautiful Cape May warbler, the only one seen by the writer, against dozens other years, was skulking along the fence of a disreputable looking dog pound. The Blackburnians seem to have been the greatest sufferers. Several dead warblers, two tree swallows, a brown creeper, were brought to me by school children, others were brought to the museum, three Blackburnian warblers were found dead by a friend at Germanicus, Renfrew County, and farmers and their children at this place, also at High Falls, Quebec, all told the same story. Some had found two, others as many as five dead warblers; at least, according to the descriptions given, they belonged to this family. I found a dead Blackburnian warbler on the banks of the Lievre River at High Falls, where, according to the testimony of a farmers' family, they had been very common in May, some not able to fly away and a number found dead. At Germanicus a strange incident was observed. On a farmer's bridge through a swamp a myrtle warbler was in its last agonies, when a robin came and tried to carry it away. Why?

Now it is safe to assume that for every bird found dead, hundreds, if not thousands, are not found, showing a consequence of the backwardness of the season, that may well stagger a nature lover.

Another and very curious effect of this lack of food in the accustomed places was the apparent change of habit it induced some species to adopt, the warblers again being the most affected. If a person had begun the study of birds, or at least of warblers, this spring, near here, he would have formed many an erroneous opinion, and yet would have had observed facts to base them on. He would *e.g.* not have had any hesitancy in stating, that most warblers were ground loving birds, looking for their food on the grass. For this is precisely what the yellow, Blackburnian, Canadian, and other warblers could be seen doing day after day in May. During a walk on the 20th, I saw 10 to 15 yellow warblers, all on the ground or on old weed stalks, etc., not far above it. The same was told the writer by farmers in Renfrew County, by a returned lumberman from Lake Kippewa, who said that on every small spot of grass in the woods or on the farm, these little "black and yellow," etc., birds, that they had "never noticed before" were abundant. They were very tame, too, allowing one to catch them, caused, as already indicated, by their starved condition. On May 4th, after that great snowstorm, four hermit thrushes came out of the pines on the veranda of Mrs. Brown's residence, Ottawa East, to within three or four feet of Mrs. Brown and Miss Lees, who were standing in plain sight of them on the inside of a window, which shows much more tameness than this species usually shows. Another curious change of habit could be observed in the myrtle warbler. It was almost invariably to be seen in cat-tail swamps, where, however, no sign of new growth was yet to be seen, darting over the water, most probably after the few flies, etc., there, in the most approved flycatcher style. A beginner would have undoubtedly classed the myrtle warbler as an exclusive swamp bird. Altogether, judging from the number of yellow and Blackburnian, etc., warblers at the edge of rivers and pools, that must be the last place where insects can be found when absent everywhere else.

Nesting was naturally also greatly affected. The delayed arrival of many species would, of course, also postpone the time of nesting. Even such that were here on time, or even earlier than usual, like the robin and red-winged blackbird, delayed nest-building in many instances, owing probably to the fact that the leaves and cat-tails were so late coming out, which would have left their nests too much exposed. This must have been a consideration with the robins at least, for never have I seen and heard of so many nests of robins built on houses, under verandas, over doorsills, etc., and that in places where trees are plentiful.

Finally the untowardliness of the season caused some species to remain with us a much shorter time than usual. They delayed coming to us longer than under normal conditions, and, wanting to get to their breeding ranges at the usual time, they had to cut short their sojourn here. This was the case with the rusty grackle and the white-crowned sparrow; the tree sparrow too was not seen by most observers, and the blackpoll warblers, while a few single individuals were seen much later than usual—I observed one at High Falls, Que., as late as June 12th—made the total length of their stay shorter than otherwise, owing to their much later arrival. Bay-breasted, Tennessee and blackpoll warblers, olive-backed thrushes and pine siskins were seen and heard in full song as late as June 7th at Major's Hill Park, which will probably not happen again for years.

I add a comparative list, which begins where the one in the May number left off, with April 22nd.

	1907	1906	1905
Yellow-bellied Sapsucker..........	April 27	April 15	April 10
Downy Woodpecker..............	" 27	" 8	" 11
Purple Finch.....................	" 27	Mar. 29	Mar. 1
White-throated Sparrow...........	" 28	April 15	April 23
Ruby-crowned Kinglet..............	" 28	May 1	" 27
Myrtle Warbler.....................	" 28	" 2	May 1
Purple Martin......................	" 26	April 22	April 23
Whippoorwill......................	May 5	May 1	May 5
House Wren....................	" 9	" 2	April 28
Chimney Swift....................	" 10	April 30	May 2
Black and White Warbler...........	" 10	May 4	April 28
Woodcock......................	" 11	" 11	
White-crowned Sparrow..........	" 13	" 16	May 6
Yellow Warbler....................	" 13	" 4	" 1
Blackburnian Warbler..............	" 13	" 10	" 1
Rose-breasted Grosbeak..............	" 13	" 13	" 11
Brown-breasted Nuthatch.........	" 13	Mar. 10	Mar. 1
Bank Swallow.....................	" 14	May 13	May 18
Redstart......................	" 14	" 15	" 5
Waterthrush......................	" 14	" 11	" 8
Kingbird.......................	" 14	" 7	" 5
Baltimore Oriole..................	" 14	" 13	" 6
Ovenbird......................	" 14	" 13	" 6
Canadian Warbler................	May 15	May 19	May 12
Parula Warbler..................	" 15	" 7	" 10
Black-throated Blue Warbler......	" 15	" 7	" 10

	1907	1906	1905
Goldfinch	May 15	April 17	Mar. 13
Least Flycatcher	" 15	May 11	May 5
Nashville Warbler	" 15	" 7	" 7
Magnolia Warbler	" 15	" 16	" 10
Veery	" 15	" 6	" 6
Wilson's Warbler	" 15	" 21	" 19
Scarlet Tanager	" 15	" 17	" 14
Nighthawk	" 16	" 16	" 14
Warbling Vireo	" 16	" 6	" 10
Bay-breasted Warbler	" 16	" 16	" 19
Red-eyed Vireo	" 16	" 15	" 6
Black-throated Green Warbler	" 16	" 7	" 1
Tennessee Warbler	" 16	" 17	" 24
Cape May Warbler	" 16	" 12	" 22
Olive-backed Thrush	" 16	" 13	" 16
Northern Yellowthroat	" 16	" 11	" 4
Catbird	" 17	" 15	" 6
Chestnutsided Warbler	" 17	" 13	" 7
Bobolink	" 18	" 5	" 2
Crested Flycatcher	" 19	" 11	" 12
Blue-headed Vireo	" 19	" 15	" 7
Cliff Swallow	" 19	May 9	May 17
Rusty Grackle	" 19	" 7	April 10
Spotted Sandpiper	" 19	" 2	May 4
Sora	" 19	" 8	
Solitary Sandpiper	" 20	" 18	
Swamp Sparrow	" 20	April 18	May 8
Bittern	" 20	" 16	April 24
Gray-cheeked Thrush	" 23		May 14
Alder Flycatcher	" 24	May 19	" 24
White-breasted Nuthatch	" 24	April 4	
Mourning Warbler	" 29	May 19	May 12
Red-headed Woodpecker	" 29	" 26	
Blackpoll Warbler	" 31	" 21	May 17
Pewee	" 31	" 17	" 4
Hummingbird	" 30	" 15	" 11

Note that in the list for 1907 there is only one species recorded between April 28th and May 9th, the whippoorwill, while in a chronologically arranged list of 1906, there are 23 species recorded as having arrived, three on the 1st, three on the 2nd, three on the 4th, two on the 5th, three on the 6th, and seven on the 7th. Of rare species like the Tennessee warbler, the dates given above are not conclusive, they may have been here for days before, but escaped observation.

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