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THE VANISHED BUFFALO.

BY PROF. EDWARD E. PRINCE,

Dominion Commissioner of Fisheries.

It is hardly possible for the thoughtful traveller to cross the prairies of Western Canada without some reflections on the vanished buffalo. That these apparently interminable plains, now so silent and destitute of animal life, were once the pasture ground for incredibly vast herds of bison or American buffalo (*Bos americanus*) can scarcely be realised. For fully a couple of days the Pacific express speeds across this treeless waste, clothed with brown grass except in summer when it is carpeted with the strange flowers peculiar to these monotonous plains. In every direction the flat waste melts in the blue distance like the sea in mid-ocean but no sign of life appears except a few birds, and that ubiquitous prairie rodent, the gopher. Herds of domestic cattle, the property of isolated ranchers, roam at will; but an occasional cayote or prairie wolf (*Canis latrans*, Say), a startled badger (*Taxidea americana*, Bod.), or a few antelope (*Antilocapra americana*, Ord.) may be seen hastening away from the railway track.

It is fully twenty years ago since the buffalo in any considerable numbers were found on the plains. In 1884 out of a herd of twenty, eleven or twelve were killed in the vicinity of Cypress Hills not far from Maple Creek, and so recently as eight years ago a small herd of six or seven cows and calves was killed by Indians a little north of Swift Current, Assiniboia, N. W. T., these being probably the remnant of the Cypress Hills buffalo. In the early part of 1886 the Smithsonian expedition scoured Montana with the hope, a very meagre one, of finding

some living buffalo, and no less than 24 specimens, including 10 old bulls, were killed. The wood-buffalo still survive in remoter parts of the North West ; but they are probably not numerous, and are doomed to early extinction with the present opening-up of these distant gold producing areas.

Observers who crossed the prairies, before the buffalo were nearing extermination, confess that no description can do justice to the impressive spectacle which these bovine monsters presented. Their brown almost black forms scattered over the plains and quietly grazing in untold numbers or spurred by fear and fury rushing in irresistible stampede and leaving clouds of dust behind, can be only dimly imagined. Single herds of ten thousand buffalo were not at all uncommon, and nothing could resist the shock of these legions when in stampede. Fences, tents, waggons, even settlers' huts were thrown down, and railway trains have been compelled to stop until the monstrous troop passed by or run the risk of being overturned by the onward sweep of the buffalo.

The narrow winding paths along which they moved in single file can be still clearly seen upon the prairie, radiating in every direction and converging and crossing each other, while the hollow basins in the earth, the "wallows" where they rolled in the dust, or in wet mud where the ground was marshy are distinctly visible though hollowed out twenty or thirty years ago. Of the thousands of paths to be clearly discerned by the traveller on the C. P. R. west of Winnipeg, a large proportion run nearly north and south and indicate no doubt seasonal migrations from the usual summer resorts to more southerly winter grazing grounds. Six or eight paths frequently run side by side, and as the western rivers usually take an east and west course, the buffalo paths lead to water. Some of the paths are stated to have been worn down to a depth of 24 to 30 inches so vast where the long lines of buffalo which tramped along them.

If it is hardly possible to adequately picture the roving buffalo herds as they appeared a quarter of a century ago, we can happily still form some conception of their imposing and

even terrible aspect from the few living specimens that yet survive. Those survivors, like the couple of hundred in the Yellowstone Park, Montana U. S. are either in a practically wild state, under protection more or less effective, or in a confined park, securely fenced in, as at Silver Heights, near Winnipeg, where a herd of sixteen or seventeen roam in an extensive enclosure.* Col. Bedson, ten years ago had 70 or 80 of them, pure bred, at Stony Mountain, near Winnipeg but they have been sold and form part of the herd of Mr C. J. Jones, Garden City, Kan., which probably numbers about 150 full blood buffalo. Mr. W. F. Cody and others have a few specimens, but there can hardly now be more than 1000 of these noble animals remaining of the countless myriads which not long ago peopled the plains.

Lord Strathcona had kindly suggested on my visits to the west that I should view his herd at Silver Heights, but the opportunity did not occur until last August, and my notes, made at the time may be of interest although nothing that is new or of scientific importance can now be said of the buffalo. The herd have a fenced reserve covering eight or ten square miles, and over this grassy park they wander with as much freedom as in nature. Some horses feed on this ground; but, while the buffalo do not associate with them much, there appears to be no animosity between them. One of the horses was injured, I learned, some months before, but the animal was possibly lame or weak, and unable to quickly get out of the way of the buffalo. Weak members of their own tribe are invariably attacked and killed. The principle of the survival of the fittest finds rigorous fulfilment among the buffalo. When a friend and myself reached the farm, the buffalo had not been seen for some hours, and were said to be several miles away. We determined to find out their whereabouts, but like other visitors who departed disappointed at not seeing the buffalo, we were just beginning to share in the same feeling, and were about to give up hope of viewing the herd, when we observed two

*Since these notes were jotted down Lord Strathcona has gifted his herd to the Dominion for the Banff National park.

buffalo rapidly making for the cattle sheds where troughs of water stand. They were busily drinking as we approached, and we imagined that they were pretty well domesticated. We were quickly undeceived. In the first place, they were drinking out of the small pools formed by water overflowing from the adjacent pump. They are never known to drink out of the spacious troughs provided with clean water. In the second place a slight breeze arose and blew towards them from our direction. The effect was instantaneous. They raised their heads, sniffed suspiciously, curled their tails aloft, and bounded away with lightning speed. One gained some idea of the strength and swiftness of the buffalo, for these two monsters bounded away lightly as deer, and in a few minutes were lost to view. Their fear of man is still strong, and they retain so much of their original wariness, that anything touched by human hands they avoid. Hence they refuse to enter the cattle sheds in winter, and prefer the snowy waste. They will not even lie down upon dry straw which was thickly spread over the snow for them. Hence also they refuse to drink out of troughs, buckets, or any vessels placed for cattle or horses, and invariably quench their thirst at mud-puddles and small scattered pools of water. Foxes, bears, etc, exhibit similar wariness, and are able to detect the touch of man's hand on traps set for their capture. Hunters adopt many devices to elude this keen sense of smell, which warns wild animals of danger. Castor, which the beaver hunter procures, is invaluable for smearing traps set for certain fur animals.

We feared that the startled pair had rejoined the herd and that all would have hurried far away. That they were shy we had been assured. They were also less trustworthy than formerly, having been much disturbed by numbers of visitors, some of whom had thoughtlessly teased the animals. We were cautioned if we went in search of the buffalo to move quietly and slowly. Sudden movements or noises startle them, and they either rush off in stampede and may not be visible any more that day, or they turn threateningly upon the intruders.

Fortunately we found the herd leisurely feeding in the open not very far away from the farm buildings. They had been rejoined by the two animals which we had disturbed, but the whole herd were coming in for water.

There they stood like great bronze monsters statuesquely surmounting a slight eminence on the grassy plain. It is difficult to accurately describe the impression produced upon the spectator when he first beholds a living buffalo. Something of sentiment will naturally mingle with his thoughts, but apart from the feeling that he is beholding one of the last of a tribe of noble game, practically extinct, he is awed by the massive uncouthness of the animals. Uncouth and monstrous they are, yet noble and grand. A fine specimen of an adult lion in life never fails to impress the spectator, but he realises that it is a huge cat, a gigantic type of a familiar mammal. The buffalo recalls no other animal with which the spectator is acquainted. It is a wholly unfamiliar form, and unlike any other creature which the observer has seen before. For myself I had a feeling akin to that experienced when I have discovered upon some leafy branch a huge caterpillar rearing its bushy head in proud defiance—a strange delight and curiosity. The buffalo struck me as resembling in some features a bull, in others a lion, in others a bear, in others a colossal mule, yet really unlike any of them. His limbs resemble the first ; his mane, the second ; his dark furry head and cheeks, the third ; his body and tail, the last-named. The combination is a grotesque one, yet it is not wholly fanciful, and I was interested recently to find in Hornaday's report on the buffalo, a quotation from a writer in 1724, who gives his impression in these words : "a wonderful combination of diverse animals. It has the crooked shoulders with bunch on its back like a camel, its flanks dry and tail large, and its neck well covered with hair like a lion. It is cloven-footed, its head armed like a bull, which it resembles in fierceness, with no less strength and agility." The effect, at any rate, is as strange as it is impressive. The animals, as already stated, were grouped upon slightly rising ground, and their dark forms contrasted strongly with the

pale tints of the surrounding pasture. We moved quietly towards them ; but they appeared unconscious of our presence and with noses to the ground continued browsing. Not until we were within 60 or 70 yards did they appear to be aware of our presence. They all raised their heads together, turned and stared at us curiously. The small calves, of which there were several, kept at the further side of the cows, and ran hither and thither as if afraid. The bulls stand very high at the shoulder, the height being increased by the curly mane, which is golden or tawny, glistening like silk. A height of 5 ft. 8 in. appears to be a maximum measurement though the bushy mane adds another 4 or 5 inches. A short ridge of stiff bushy hairs extends behind the shoulders along the middle line of the back. The mane shows a distinct line of demarcation passing diagonally down from the back forward to the front legs. Behind this line the body is of a rich sooty-brown with a silky sheen like the coat of a well-groomed horse. In winter the hair becomes long, thick, and matted, and gives the buffalo a very different appearance. The tail is rather like that of a cow, or rather a mule as it is short and has a very slight terminal brush. The body slopes backward and diminishes very rapidly behind the massive shoulders. It falls away very much as does the body of a lion. Indeed, the appearance of the buffalo in many respects is suggestive of the lion. When the animal turns round the view from behind recalls the small and slender body of the mule or ass, but bears little resemblance to that of the ox or of the horse. A bushy conical beard of jet black hair hangs from the under side of the head in the bull buffalo. The horns are smooth and grey, not polished and black like those burnished for ornament. They are very sharp, and are gracefully curved upward and to the front. Between the horns, and above them, the hair of the forehead is long and thick and stands erect like plush or the pile of the richest black velvet. Later, in winter it may become paler and brown, and matted or curly ; but seen as I saw it, late in the summer, it did not appear woolly or curly, but erect and thick, so that it was blown about by every breath of

wind. The ears are not prominent. The snout is wholly unlike that of a horse, being blackish or dark grey, wet and shining, and so blunt and crinkled that it might be compared to the nose of a bull-dog. It certainly reminds one less of a cow than of a huge pug or bull-dog. I confess to a feeling of fear when standing fifteen or twenty yards from the full grown bull. He looked so much like a monstrous bull-dog, with no trace of mildness or docility. When the whole herd raised their heads and gazed at us the effect was not reassuring. They are not at all trustworthy, and the cow-buffalo, when her calf is young, is very fierce. They will not brook impediments or obstructions and will throw such down rather than divert their course. The massive skull, and the cushion of hair in the frontal region, enables the buffalo to charge an obstruction without injury. They are very obstinate, and a few weeks prior to our visit one of the Silver Heights buffalo had to be shot. He got into the vegetable garden, and was busy ~~digging~~ turning up the beds and throwing down the crop, and every means taken to stop his unruly proceedings failed. It was found impossible to eject him. He made terrific rushes at the men who attempted to drive him out—nothing could move him, and the only feasible course appeared to be a dose of lead. When the herd are disturbed they gallop off in a straight line. Nothing can turn them aside. They never tire, but go on and on with their tongues hanging out like monstrous dogs, and no horse has sufficient endurance to keep up with them in a lengthened run. They are said to bellow at times like a bull; but as a rule are perfectly silent. When wounded, especially by a shot breaking one of their legs, they endeavor to rise and charge at the hunter, snorting fiercely and glaring in the most savage manner. Many a hunter has been awed by the splendid fury of the wounded buffalo; but unless the region of the heart or some vital part were penetrated, bullet after bullet might be discharged at the head or shoulders without effect. In early days when the Indian pursued the buffalo with bow and arrow, instances were common, of an arrow directed at the heart passing clean through the buffalo's body,

and out on the further side, so terrific was the force of the Indians' bow and so closely were the victims approached. The colour of the calves is uniform, not spotted or striped, and is much the same as that of the cows. The cow is invariably smaller than the bull and lacks his sullen ferocity and massive grandeur. Both sexes possess horns. The voice of the bull is a deep sonorous bass call or growl, and in the distance, especially when several bulls were bellowing together, it is said to have resembled the roll of distant thunder.

Among many traditions still current, old settlers have one respecting the so-called "sharpening-places," *i.e.*, low rocky cliffs in the "coulees" or hollows of the prairie where the bulls were said to rub their horns in spring in preparation for the pairing period in August or September. The bulls were fierce fighters, but this sharpening of the horns is probably a myth. I have, however, several pairs of very thick old horns, which are quite worn down by rubbing upon one side of each horn. Possibly this rubbing was done when the buffalo rolled upon the ground, a habit which was constantly indulged in, partly no doubt to get rid of the flies, which annoy them just as they annoy the caribou on the barren plains of the north. The tips of the horns in old bulls, are often narrow and pointed at the tip, but very thick, clumsy, and corrugated down to the base.

All attempts to induce the buffalo to shelter in winter, or even to lie down on beds of straw in the open air have failed at Silver Heights. Straw was abundantly laid down for them in winter, but they invariably preferred some place well covered with snow, where they lay down and slept.

While the extinction of the noble buffalo may be justifiably deplored, it is questionable whether the western country could have been settled, or crops profitably grown as long as their immense herds roamed at will. Certainly man's ferocious barbarity and love of merciless slaughter would have continued so long as any wild buffalo remained to be butchered.

AN OTTAWA NATURALIST'S JOURNEY
WESTWARD.

III.—THE ALEUTIAN ISLANDS AND BEHRING SEA.

BY ANDREW HALKETT,

Marine and Fisheries Department.

The Aleutian Islands present unusual physical features. Some are craggy and barren, but many, although wholly devoid of trees, are densely covered with a low growth vegetation; such floral forms as irises, blue-bells, anemones, daisies, &c., growing in rich profusion, and lending a charm to the islands. I arose between three and four o'clock one morning to see the Entrance to Captain's Bay. That was a dreary dismal morning in a wild place. A very heavy mist hovered over the precipitous rocks, between which appeared intervening spaces of verdure. A few hours later the vessel anchored at Dutch Harbour, near the village of Unalaska.

This village is an interesting and picturesque place. It is situated in the midst of mountains in a beautiful bay. An ornament to the village is a neat little Russo-Greek church. It is a wooden structure, built in a somewhat oriental style, having, instead of spires domes with crosses on their tops. The Russo-Greek ritual, a very ancient form of nominal Christianity, and a most imposing ceremonial, is the recognized religion of the Aleuts.

I was delighted to see in this far-off village, a domesticated flock of Canadian Geese (*Bernicla canadensis*) comprising fourteen fine birds, but they were by no means so handsome as the specimens of this goose at the Central Experimental Farm. Apparently they were of the variety known as the Smaller White Cheeked Goose (*B. c. leucoparia*).

At the village, and around the island of Unalaska were numbers of Ravens (*Corvus corax*, L.), and as I found the broken tests of sea-urchins at considerable distances from the sea, it is

possible that these birds carry them to considerable heights, and dropping them descend to feed upon their contents.

To a naturalist the bay at Dutch Harbour is a fascinating spot. Mollusks are rich, as to numbers, in both species and specimens. In places exposed to the beating waves were found in plenty the beautiful striped Chiton known as *Tonicella lineatus*, Wood; and a species of *Anomia* with thin perlaceous valves of such pleasing deep lustrous green, that it might vie with many a tropical shell. Upon the stones, high and dry, awaiting the return of the tide, are innumerable gastropods called *Littorina sikhiana*, Philippi. They are of a dull but often variegated colour, and have a wide distribution. I saw them in plenty at Vancouver Island, and specimens collected in Siberia are in my possession.* The shell of this species is thin, and the edge easily broken, and therefore in this respect is unlike the thick shell of the Scotch "Buckie" or British Periwinkle (*Littorina littorea*, L.) Numerous specimens of *Purpura lima*, Martyn; and various Limpets (*Acmæa*) were found in the pools.

At another spot, some miles down the shore from the village of Unalaska, I found a neat little specimen of the genus *Natica*, with a close shutting calcareous operculum.

One evening two of the seamen went fishing, and I accompanied them. We rowed over the bay in full view of the islands until we were several miles away from the schooner. We caught a number of cod-fish, halibut, skulpins, and rock-cod.

Near by on one of the mountains were some Bald-headed Eagles, and as one of them had settled on a crag, high over head, we resolved to climb the cliff, in order to get a better view of this really magnificent bird. We arduously toiled our way to the top, clutching moment by moment the firm vegetation, but were well repaid with the excellent view we obtained of the eagle when parallel with it. It was a fine sight to see the large bird up there, and it repeatedly opened its great beak in a threatening manner. The Bald-headed Eagle (*Haliaetus leucocephalus*, Linn.) belongs to the Falcon family of rapacious birds.

*Collected by Mr. R. N. Venning, Dept. of Marine and Fisheries.

It is of a dark brown colour, with a white head and tail, and the feet, bill, and eyes are yellow. It preys largely upon fishes. Although scarcely so handsome a bird as its ally the Golden Eagle (*Aquila chrysaetus*, Linn.), yet this is the species which has been honoured as the emblem of the United States. An egg of the Bald-headed Eagle, from Long Island, Lake Erie, is in my possession.* The nest was built near the top of an elm tree, about 70 feet high, and contained two white eggs.

At the end of July the schooner which had been anchored for some time near Dutch Harbour, made her way into the open waters of Behring Sea. Having left the Entrance to Captain's Bay behind, on one side of which is a promontory rock called the "Priest"; and on the opposite side a water-fall, pouring itself over the cliff—the first notable thing we observed in the sea was a number of Fin-back Whales (*Balænoptera velifera*, Cope). These huge Cetaceans were often close to the vessel's side, and shewed their great mouths and blow-holes (nostrils). The blowing, which is respiratory, is very audible. At one spot and time the water was fairly agitated as these monsters rolled over, but unfortunately only a small part of the creature's body can be seen at the same moment, for if the head is above water the tail is under, and *vice versa*.

One day when far from land, I scooped up a specimen of Medusa from the surface of the sea; and finding it tenacious of life placed it in a glass-vessel containing sea-water, in order to watch its graceful motions, and examine its structure. It was of a soft brown colour: very complicated and delicate in its organization, but probably belonged to the genus *Chrysaora*. The Medusæ differ considerably among themselves, but are generally mushroom shaped, and from the body, or disc, are suspended numbers of tentacles. Besides this small form many other Medusæ were seen during the voyage, and whilst approaching the Straits of Juan de Fuca, when "homeward bound" we passed through a regular field of them. On that occasion various

*Collected by Mr. W. H. Noble.

species were observed, and many specimens were nearly a foot in diameter.

A few days afterwards I scooped up another Cœlenterate, very different from the Medusa, but equally as beautiful. This was a species of Ctenophore.* It was of a transparent white colour, with a red internal part, and bright yellow spots underneath.

The beautiful, but grotesque looking, Puffin or Sea Parrot (*Luna cirrata*, Pall), is frequently seen in Behring Sea. With its brilliant colours it suggests the ludicrous among birds, almost as much as the mandrill does among mammals. The head is white with yellow tufts, the bill green and red, the legs red, and the general colour of the body black.

While on deck one night, when all was quiet, and it was calm, mild, and still on the sea, I heard the cry of a Murre--never heard by me before. It was a simple and single "mur" each time, coming from the distance, and at once revealed why the bird had been so named. The Murres (*Uria*) of which there are a number of species inhabiting both the Atlantic and Pacific are dark coloured above and white below, and are frequently to be seen in the Behring Sea, either on the wing or resting on the surface of the water. I saw one one day when hundreds of miles from land, on the surface of the waves with her brood, which consisted of a single young one; for the Murre lays only one egg at a time. Countless thousands, however, of these birds congregate together among the rocks during the breeding time, so that Murres' eggs have considerable commercial value. In large collections of the eggs the most varied ground colours and markings are displayed: the ground colours are different shades of white, different shades of green, bluish, grayish, earthy: the markings are spots, blotches, and zigzag lines of brown, black, or lilac: occasionally eggs are devoid of markings.

At times I have seen great numbers of sea-birds, when out in a boat on the open sea. On one such occasion hundreds of

*The Cœlenterata are divisible into the Hydrozoa and the Actinozoa—the Medusæ belong to the former, and the Ctenophora, along with Corals, Anemones, &c, to the latter.

Gray Fork-tailed Petrels (*Oceanodroma furcata*, Gmel.) were seen resting on the bosom of the water, also an occasional Murre flying past and three Terns hovering about over head.

The Terns were particularly beautiful: the head was black on the top, the back ashy grey, the breast pure white, the tail forked. I was attracted to them by the cry. I was further unable to examine this tern, as one example came on board towards night-fall, and I had it in my hand. There was a white mark along the crown of the head, and I would have pronounced it the Aleutian Tern (*Sterna aleutica*, Baird), except that the bill was orange on the under mandible, and Coues says the bill of that species is black. The feet were also orange: the hallux small and well set behind the tarsus. It was seemingly a young bird and tired, and so had sought a resting place on the deck of the vessel. I took it down to the cabin and put it on the table, where it dressed its feathers with its bill and pecked at my finger. I then released it. Away it soared, far up into the air, the wind and the waves congenial, far distant from the land.

ANDREW HALKETT.

Ottawa, 30th June 1898.

LIQUID HYDROGEN

A notable event in the history of chemistry is being chronicled in the scientific journals. At the meeting of the Royal Society (England) on the 12th May last. Professor Dewar, a chemist eminent by reason of his successful research work at low temperatures, announced that by means of special apparatus, a pressure of 180 atmospheres and a temperature of -210 degrees C. he had liquefied hydrogen. It has only been within the last few years that oxygen, nitrogen and air have been liquefied; the liquefaction of hydrogen and helium, the last of the so-called permanent gases, is now an established fact.

The apparatus for this achievement, says Dr. Dewar, "took

a year to build, and many months were occupied in testing and making preliminary trials." Success attended the experiment made on May 10th when hydrogen gas at a temperature of -205 degrees C. and under a pressure of 180 atmospheres "was allowed to continuously escape from the nozzle of a coil of pipe at the rate of 10 to 15 cubic feet per minute, in a vacuum vessel doubly silvered and of special construction, surrounded with a space kept below -200 degrees C." Under these conditions liquid hydrogen began to form in drops, until in five minutes there were about 20 c.c. of liquid hydrogen. Further liquefaction was prevented by "the solidification of the air in the pipes of the apparatus, closing the orifice of the hydrogen jet." It is thus evident that air freezes at a temperature higher than that at which hydrogen becomes a liquid.

Liquid hydrogen, according to Professor Dewar, is colourless and clear, with a high refractive index and a density evidently greater than that ascribed to it by theory, namely, .10 to .12. Its boiling point had not then been determined, but that it is excessively low was proved by immersing in the liquid hydrogen the closed end of a glass tube containing air. The tube as far as it was immersed became filled with solid or frozen air. A further experiment made by Professor Dewar in this connection was the liquefaction of helium (a recently discovered element) by placing in liquid hydrogen a sealed tube containing this hitherto considered permanent gas

This highly interesting and valuable paper goes on to state that chlorine was liquefied by Faraday in 1823, that sixty years afterwards, Wroblewski and Olszewski produced liquid air and that now fifteen years later the two last of the gaseous elements to baffle efforts at liquefaction had been obtained as static liquids.

Professor Dewar concluded by saying that "with liquid hydrogen as a cooling agent, a temperature could be reached within 20° or 30° of the zero of absolute temperature, and its use would open up an entirely new field of scientific enquiry. Nobody could predict the properties of matter near that zero."

F. T. S.

BIRD NOTES FOR JUNE.

EDITED BY W. T. MACOUN.

By the time June has arrived most of the birds which come to Ottawa have put in an appearance, so that there are never many new records for that month. Those birds which are noted for the first time had probably been here for some days, but were not seen previously this year. Mr. F. A. Saunders has done very good work during the month of June, and had he not kindly furnished us with his records, there would have been but few bird notes for this month. He was fortunate enough to add two new species to the list of Ottawa birds, namely, the Short-billed Marsh Wren (*Cistothorus stellaris*), and the Grasshopper Sparrow (*Ammodramus savannarum passerinus*).

The following observations were made by Mr. Saunders :

June 11—American Sparrow-hawk, *Falco sparverius*.

“ 11—Pine Warbler, *Dendroica vigorsii*. A pair breeding at the Experimental Farm.

“ 11—Canadian Warbler, *Sylvania canadensis*. Breeding in Dow's Swamp and elsewhere.

“ 11—Long-billed Marsh Wren, *Cistothorus palustris*. Common near the canal.

“ 12—Mourning Warbler, *Geothlypis philadelphia*. Seems to be getting much commoner. Breeds in Dow's Swamp and elsewhere.

“ 13—Least Bittern, *Botaurus exilis*. A pair, doubtless breeding, in marsh at Experimental Farm.

“ 13—Sora (Carolina Rail) *Porzana carolina*.

“ 14—Winter Wren, *Troglodytes hiemalis*. Dow's Swamp.

“ 14—Water Thrush, *Seiurus noveboracensis*. Dow's Swamp. Breeds regularly in same place.

“ 14—Red-breasted Nuthatch, *Sitta canadensis*. Dow's Swamp.

“ 15—Olive-sided Flycatcher, *Contopus borealis*. Mer Bleue.

“ 15—Yellow Palm Warbler, *Dendroica palmarum hypochrysea*. Mer Bleue. Common.

“ 15—Short-billed Marsh Wren, *Cistothorus stellaris*. One seen in Mer Bleue. June 17, two seen and one shot. This is a new species for Ottawa.

“ 16—Parula Warbler, *Compsothlypis americana*. Chelsea.

“ 24—Grasshopper Sparrow, *Ammodramus savannarum passerinus*. One seen beyond Hull on the 24th, doubtless breeding. Seen in rear of Experimental Farm on 26th and 27th, and one shot on the 28th. This is another addition to Ottawa's bird list. The Grasshopper Sparrow was not taken previously nearer than the St. Clair Flats.

BIRDS' NESTS AND BREEDING PLACES.

PRAIRIE HORNED LARK—On the 8th of June a nest of the Prairie Horned Lark was found in the arboretum at the Experimental Farm by Mr. Macoun. The nest was in a hole in the lawn and contained three eggs. Young fledged birds were flying about at the time.

BROWN THRASHER—A Brown Thrasher's nest was found by Mr. Macoun in the arboretum at the Experimental Farm on the ground on the 16th of June. The nest contained three eggs and was built at the base of a climbing honeysuckle. Later the nest contained four eggs.

MARYLAND YELLOW-THROAT.—On the 22nd of June a nest, containing three young and one egg, was found by Mr. Macoun at the Mer Bleue. The nest was at the base of a small shrub. On the 23rd a nest was found in Dow's Swamp at the foot of a plant of Meadow Rue, with four young, apparently but recently hatched.

AMERICAN BITTERN—Miss Harmer reports that Prof. Macoun found a nest with three young, half-grown, at Moore's Landing on the 25th. The nest was in a tuft of marsh grass.

NASHVILLE WARBLER—Breeds in Dow's Swamp, Mer Bleue, Chelsea, etc. Mr. Saunders.

BLACK-THROATED BLUE WARBLER—June 16th. Breeding in the grove at Chelsea and in hard woods northward.

BLACKBURNIAN WARBLER—June 24th. Breeding in the grove at Chelsea Mr. Saunders. At Moore's Landing. Miss Harmer.

YELLOW-BELLIED FLYCATCHER—June 15th. A nest found in Mer Bleue with young. June 24th. A nest found at King's Mountain with young, Mr. Saunders.

The following notes of birds seen at Long Island, Lake Erie, were sent by Mr. L. J. Boughner: *Corvus americanus*, June 1st; *Gallinago delicata*, 1st; *Icterus galbula*, 1st; *Megascops asio*, 2nd; *Colymbus auritus*, 4th; *Ægialitis vocifera*, 4th; *Zenaidura macroura*, 4th; *Colaptes auratus*, 3rd; *Petrochelidon lunifrons*, 3rd; *Spizella socialis*, 5th; *Urinator arcticus*, 6th; *Ceryle alcyon*, 9th; *Melospiza fasciata*, 10th; *Agelaius phœniceus*, 11th; *Melanerpes erythrocephalus*, 10th; *Larus argentatus*, 13th; *Anas obscura*, 11th; *Antrostomus vociferus*, 14th; *Dolichonyx oryzivorus*, 13th; *Podilymbus podiceps*, 17th; *Botaurus lentiginosus*, 17th; *Aix sponsa*, 17th; *Clivicola riparia*, 17th; *Sayornis Phæbe*, 20th; *Poocætes gramineus*, 21st; *Sialia sialis*, 21st; *Galeoscoptes caroliniensis*, 21st; *Tyrannus tyrannus*, 23rd; *Tachycineta*

bicolor, 27th ; *Urinator imber*, 28th ; *Bonasa umbellus*, 28th ; *Halicæetus leucocephalus*, 29th ; *Arden herodias*, 29th ; *Grus americana*, 29th ; *Trochilus colubris*, 30th.

FRESH WATER FOUND BY BORING IN GRANITE AND OTHER HARD CRYSTALLINE ROCKS.

Sir Clements Markham, K.C.B., President of the Royal Geographical Society of London, draws attention* to a remarkable discovery recently made by Baron Nordenskjold, viz :— that fresh water will be found by boring through hard crystalline rocks to a depth of from 30 to 35 metres, *i.e.*, from 100 to 120 feet.

The practical utility of this fact becomes very apparent in a country like Canada, where Archæan rocks are so extensively developed, and especially so on islands or isolated areas where fresh water does not readily flow at the surface.

As early as 1867, in his "Sketch of the Geology of Spitzbergen Island," Stockholm, Baron Nordenskjold gave the results of a series of observations from borings in rocks of Carboniferous Age capped by others of Tertiary Age, the latter being quite folded and disturbed, the former having alternating bands of plutonic rocks interstratified with them. In attempting to account for the crumpling of the Tertiary rocks by means of an almost imperceptible but nevertheless continually operating force, he points out that differences of temperature at different times of the year are sufficient to cause dislocation of the strata, and "it should not surprise us," he goes on to say, "to find even the newest formations greatly folded, while older formations in the vicinity may be quite undisturbed." These facts taken into consideration with the general occurrence of cracks and fissures in all rock formations, he argued that in all solid rocks at an insignificant depth below the surface a horizontal crack would generally exist.

A series of borings was carried on in Scandinavia under the Baron's supervision, with results that have more than fully justified the hypothesis and stand he took, and warranted the expenditure of moneys in boring in the hard solid granite rocks on isolated areas and islands off the coast of Norway, leading to the discovery of fresh water at depths from 30 to 35 metres from the surface.

He had ascertained on enquiry, that the water and springs from mines and openings below or near the sea coast, was fresh rather than salt or brackish.

*The Geographical Journal, Vol. X, pp. 465.469, Nov., 1897.

The first boring undertaken in hard crystalline rocks was on the little island of Svangen, in 1891, south of Kosterfjorden. This was abandoned "because a long crack was arrived at extending from the sea to the boring-hole."

Baron Ruuth, General Director for Pilots, caused a second boring to be tried. It was at Arko, beyond Braviken in May, 1894, under the direction and supervision of Gustav Nordenskjold, the geologist Svenonius, and Director Casselli. "The rock consisted of hornblende, gneiss and diorite. As soon as a depth of 35 metres was reached they came to excellent water, yielding 450 litres an hour. The boring had a diameter of 64 millimetres." The water obtained was "perfectly clear."

At forty-four different stations water was thus obtained since the successful trial at Arko, and at Stockholm the temperature of the water reached in the bore-hole varies from 6° to 7° C. (about 43° to 75° Fahrenheit); Gelliavaara water, 13° C., or 55° Fahr.

"Baron Nordenskjold is convinced," says Sir Clements Markham, "that water will be found in the same way as in Sweden wherever hard close rock exists, with variations in temperature and not permeable."

In Canada where the Archæan gneisses, granites and diorites are so abundant, we find that the whole Archæan area is fairly teeming with flowing springs, even on the crests and brows of our Laurentide Hills. These springs or streams supply an innumerable quantity of fresh water for the numerous lakes which abound everywhere throughout our Archæan country as may be readily seen on examining the geological maps of Canada which include part of the Archæan complex.

I venture to throw out the suggestion, that, the presence of these cracks or fissures in the hard crystalline rocks of Canada is probably due to the variations in temperature to which the Archæan areas are subjected in coldest winter and warmest summer, or in the rapid and pronounced variations in temperature of alternating day and night.

Such an hypothesis appears to be in keeping with the views and facts advanced Baron Nordenskjold in Scandinavia, and the presence of such streams (many of them intensely cold in summer, indicating that they come from considerable depths) as issue from the cracks and crevices everywhere present, would account for the supply of a great deal of the fresh water in our great and small lakes. H.M.A.

METEOROLOGICAL OBSERVATIONS FOR OTTAWA, 1897.

B. C. Webber, Esq., Acting Director of the Meteorological Service, Toronto, Ont. in the absence of Dr. R. F. Supart, Director, has kindly forwarded to the Club an abstract of the Meteorological observations taken at Ottawa, Canada for the year 1897, for publication in the OTTAWA NATURALIST.

The editorial staff and members of the Club appreciate very highly the value of the annual abstract of these observations.

H. M. A.

Frequency of the Different Winds from Observations at 8 a.m., 3 and 8 p.m., Ottawa, 1897.

	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm
January	15	16	6	8	6	11	28	3	0
February	3	9	17	9	5	15	16	10	0
March	3	4	22	2	5	16	23	14	4
April	7	7	8	4	12	18	18	16	0
May	11	6	15	5	12	14	18	12	0
June.....	12	1	11	7	11	11	19	18	0
July	6	8	27	11	12	5	16	6	2
August.....	5	6	10	1	9	21	25	14	2
September.....	15	9	7	2	15	15	11	15	5
October.....	6	10	19	2	9	15	8	15	9
November.....	2	11	19	1	9	9	21	17	1
December.....	9	8	22	3	3	10	22	11	5
Year.....	94	95	183	55	108	160	225	151	24

January 18—Stormiest day of year, mean velocity 27.3 miles per hour.

“ 19—Coldest day of year, mean temperature—13°.0.

March 14—Heaviest snow storm of year, depth 6.5 inches.

“ 20—First thunder of year.

April 27—Last snow of season.

“ 27—Last frost of season.

July 8—Warmest day of year, mean temperature 83°.85.

Aug. 10-11—Heaviest rain storm of year, depth 1.20 inches.

Sept. 28—First frost of season.

October 8—Last thunder.

Nov. 9—First measurable snow, a few flakes on previous day.

Dec. 2—First record below zero—4°.3.

Abstract of Meteorological Observations at Ottawa for the Year 1897.

	MONTH.												YEAR.
	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	
Average height of barometer at 32' and reduced to sea level	30.108	30.135	30.083	30.073	29.756	29.931	29.948	29.962	30.159	30.162	30.070	30.083	30.056
Highest barometer	30.838	30.764	30.912	30.645	30.458	30.220	30.395	30.256	30.445	30.684	30.605	30.623	30.912
Lowest barometer	29.472	29.590	29.198	29.471	29.595	29.673	29.634	29.573	29.680	29.598	29.227	29.381	29.198
Monthly and annual ranges	1.366	1.174	1.714	1.174	6.863	0.553	0.731	6.683	0.765	1.686	1.578	1.235	1.714
Average temperature of air (Fah.).	13.69	17.27	24.82	43.11	54.55	62.02	72.35	64.07	59.42	47.67	29.92	17.49	42.20
Difference from average	+4.10	+6.57	+3.02	+2.81	-0.35	-2.28	+2.83	-0.03	-2.28	+3.97	-1.78	+0.49	+1.35
Highest temperature	45.5	40.0	49.9	77.0	76.0	84.0	97.2	85.2	92.0	85.0	54.0	45.0	97.2
Lowest temperature	-25.1	-12.0	-18.0	13.2	33.5	36.8	55.2	42.2	32.3	22.2	6.8	-15.6	-25.7
Monthly and annual ranges	71.2	52.0	67.9	63.8	42.5	47.2	42.0	43.0	59.7	42.8	47.2	60.6	122.9
Average maximum temperature	22.1	26.1	33.2	53.9	65.0	72.6	82.2	74.3	71.1	59.0	36.3	25.4	51.8
Average minimum temperature	5.3	8.5	16.5	32.3	44.1	51.4	62.5	52.8	47.7	36.3	23.6	0.6	32.6
Average daily range	16.8	17.6	16.7	21.6	20.9	21.2	19.7	20.5	23.4	22.7	12.7	15.8	19.2
Average pressure of vapour	0.085	0.092	0.129	0.272	0.299	0.377	0.611	0.479	0.381	0.247	0.158	0.102	0.268
Average humidity of the air	83	81	81	83	67	65	74	74	66	70	84	87	76
Average temperature of dew point	12.4	16.5	24.0	42.5	45.0	51.2	64.7	57.8	51.6	39.9	25.5	17.0	37.4
Amount of rain in inches	0.38	0.35	1.51	1.62	1.31	3.03	5.21	3.40	0.45	0.60	2.19	1.84	23.98
Difference from average	-0.12	-0.42	+0.71	+0.10	+0.88	+0.11	+1.86	+0.25	-1.89	-1.86	+0.52	+1.14	+1.28
Number of days of rain	3	2	7	10	13	14	13	13	6	6	8	4	99
Amount of snow in inches	15.5	15.7	28.6	2.0	0	0	0	0	0	0	5.8	22.9	90.5
Difference from average	-9.2	-6.9	+11.6	-2.5	0	0	0	0	0	0	-3.3	+1.0	-9.3
Number of days of snow	7	8	6	3	0	0	0	0	0	0	3	10	40
Percentage of sky clouded	61	69	58	61	64	66	57	54	42	48	66	72	60
Number of days completely clouded	12	10	17	11	12	12	12	10	5	9	16	21	146
Average velocity of wind (miles)	7.3	7.1	6.6	9.3	7.3	7.0	5.2	6.3	6.1	7.0	9.3	6.2	7.1
Number of auroras	0	0	0	0	0	0	0	0	0	1	0	0	1
Number of thunder storms	0	0	1	1	2	1	3	0	0	1	0	0	9
Number of fogs	0	0	0	0	0	0	0	0	0	4	1	0	5
Number of days without rain or snow	18	14	15	15	17	14	16	17	24	23	18	19	211

Days of rain or snow only reckoned when 0.01 inch or over fell.