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APRIL, 1901.
VOL. XV, No. 1.

THE OTTAWA NATURALIST.

Published by the Ottawa Field-Naturalists' Club.

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1901.

VOL. XV.

1902.

THE
OTTAWA NATURALIST,

Being Vol. XVII. of the

TRANSACTIONS

OF THE

OTTAWA FIELD-NATURALISTS' CLUB.

Organized March, 1879.

Incorporated March, 1884.

OTTAWA, CANADA:
OTTAWA PRINTING COMPANY (LIMITED.)

1901.

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THE OTTAWA NATURALIST.

VOL. XV.

OTTAWA, APRIL, 1901.

No. 1.

THE REPORT OF THE COUNCIL OF THE OTTAWA FIELD-NATURALISTS' CLUB FOR THE YEAR ENDING MARCH 19TH, 1901.

MEMBERSHIP.

Thirty-one members have been added to the Club during the year and nineteen names have been struck off, leaving the present membership two hundred and sixty-five.

Dr. H. M. Ami, the president, represented the Club at the meeting of the Royal Society of Canada, held in this city in May, at which he read a summary report of the work done by the Club during the year 1900.

SPECIAL LECTURES.

Dr. James Fletcher delivered two lectures on "Nature Study, with special reference to Birds," before the Normal School students, and Dr. Ami one on "Soils and their Origin, with special reference to those of the Ottawa Valley."

SOIRÉES.

The programme of Winter Soirées, as printed on page 176 of THE OTTAWA NATURALIST for December, 1900, was carried out with the following exceptions: The meeting for the 22nd of January was postponed for one week on account of the death of Her Majesty Queen Victoria; and the meeting for 6th March was put off till 12th March on account of the death of Dr. G. M. Dawson, a former president and an active member of the Club. In consequence of the latter postponement, the two papers that would have been read last Tuesday have been presented to-night.

Owing to the absence of Mr. W. T. Macoun from the city, his paper was taken as read, and Mr. E. D. Ingall was unable to give his.

EXCURSIONS.

The first sub-excursion of the season was held on the 28th April at Rockcliffe and Beechwood. About twenty were in attendance. The afternoon was pleasantly spent, but the backwardness of the season made it very difficult to find specimens of interest. Hepaticas, a few Trilliums and Dogtooth Violets, with Aspens, Willows, Red and Silver Maples, together with a few common spring flowers were all that rewarded the botanists. Mr. Gibson secured some specimens of *Grapta Faunus*, an uncommon butterfly in this district.

Three sub-excursions and one general excursion were held in May. The weather at all of these was perfect, and most pleasant and profitable outings were enjoyed.

Saturday, 5th May. Some sixty members and their friends visited McKay's Grove and Beechwood. That portion of the grove adjoining Clarkstown is being rapidly denuded of its wild character, but the botanical students found a variety of early spring flowers. The geologists examined the Keefer Bluff at the forks of the roads leading to the cemetery and found a series of typical fossils belonging to the Black River formation. Several large masses of the Coral *Tetradium fibratum* were obtained in the upper layers of limestone in the old quarry at this spot.

On re-assembling, Mr. Odell described and exhibited the larvæ of some Mosquitoes, and also some Crustaceans he had captured. Mr. Attwood spoke on the plants found during the afternoon, and Dr. Ami described the geological formations.

Saturday, May 13th. Seventy-five members of the Club, Normal School students, teachers and friends visited Beaver Meadow, Hull, P.Q. The botanists found many desirable species of plants and the entomologists captured several good specimens, while the geologists visited "the Heap" on the Aylmer branch of the C. P. R., where they found and listed over thirty species of fossils of the Trenton formation. Dr. James Fletcher, Mr. A. G. Kingston and the President addressed the members before separating.

Saturday, 19th May. Over eighty excursionists spent the afternoon at Hemlock Lake and vicinity. Two small colonies of *Columnaria Halli* were found in the upper strata of the Black River formation at Keefer's Bluff, and both fresh-water and marine shells were found in the Pleistocene deposits round Hemlock Lake. These and other specimens were described by the various leaders before the party returned to the city.

On 9th June a successful meeting was held at Britannia, and many summer flowers and insects were secured.

The first general excursion was held on May 26th to Gil-mour's Grove at Chelsea and was, as is always the case, a delightful and instructive excursion. The weather was very fine and the attendance large. Many interesting specimens were collected in all branches of Natural History.

The second general excursion was to Cumberland by the steamer *Victoria*, in which over one hundred members left Ottawa at one o'clock and returned in the evening by the steamer *Empress*, after spending several pleasant hours at the beautiful village of Cumberland. This locality is a new field for investigation, and several discoveries were made. The entomologists were much pleased at securing a specimen of the larva of the Large Tortoise-shell Butterfly, *Grapta J-album*, which had been sought for unsuccessfully for many years. The geologists found several valuable species of fossils, and the botanists succeeded in collecting representatives of no less than sixteen species of ferns along the side of the cliff.

The third general excursion was to Kirk's Ferry on the 15th September, when about 150 were present. The day was a perfect type of our Canadian autumn weather, and many interesting specimens were collected and observed. An unusual feature was the large number of plants which were in bloom at this late season, and many of the party were able to regale themselves with ripe raspberries, which were growing in profusion along the railway embankments.

At all these excursions the members assembled and listened to addresses by the various leaders on the collections made during the day and on the natural features of the places visited.

Volume XIV. of THE OTTAWA NATURALIST, containing eleven numbers and 240 pages of text has been completed, under the

editorship of Dr. James Fletcher. The volume has several illustrations and many interesting articles. Among the more important papers published this year are the following :

Some Interesting Moths taken at Ottawa, by Arthur Gibson.

Contributions to the Natural History of the Northwest Territories. The Birds of Southern Saskatchewan, by Eug. Coubeaux.

Soils and the Maintenance of their Fertility through the Growth of Legumes, by Frank T. Shutt.

The Labrador Flying Squirrel, by J. D. Sornberger.

The Two-lined Salamander, by Walter S. Odell.

Notes on Rare Birds occasionally Breeding in Eastern Ontario, by Rev. C. J. Young.

Ornithology (in several numbers), by W. T. Macoun.

Additions to North American and European Bryology (Moss Flora), by N. Conrad Kindberg.

On the occurrence of a Species of *Whittleseyia* in Nova Scotia, by H. M. Ami.

An Ornithological Incursion into Florida, by W. E. Saunders.

A Condensed Summary of the Field-work annually accomplished by the Officers of the Geological Survey of Canada from its commencement to 1865, by D. B. Dowling.

Notes bearing on the Devono-Carboniferous Problem in Nova Scotia and New Brunswick, by Dr. H. M. Ami.

Fauna Ottawaensis, Diptera, by W. Hague Harrington.

The Finding of a Flamingo's Nest, by W. E. Saunders.

Dr. Nansen's Scientific Results, by Prof. E. E. Prince.

Gannets and Cormorants, with special reference to Canadian forms, by Andrew Halkett.

Hemphillia glandulosa, by Geo. W. Taylor.

Catalogue of the Recent Marine Sponges of Canada and Alaska, by Lawrence M. Lambe.

Description of a New Species of *Unio* from the Cretaceous rocks of the Nanaimo Coal Field, V.I., by Dr. J. F. Whiteaves.

A Preliminary Note on the Amygdaloidal Trap Rock in the Eastern Townships of the Province of Quebec, by John A. Dresser.

The Nesting of the Cærulean Warbler, by W. E. Saunders.

The Annual Address of the President of the Ottawa Field-Naturalists' Club, by Dr. H. M. Ami.

Notes on the Acadian Owl (*Nyctala Acadica*) in captivity, by F. Norman Beattie.

Notes on some Land and Fresh Water Mollusca from Fort Chimo, Ungava Bay, by Dr. J. F. Whiteaves.

Notes taken in the Peace River, Athabasca, and adjacent country, by J. A. Macrae.

Two Warblers new to Canada, by W. L. Kells.

Besides these longer papers there are numerous short notes on scientific subjects, book reviews, etc.

The Treasurer reports that after paying all expenses he has \$256.46 on hand.

The Council recommends that the following gentlemen be made corresponding members of the Club in recognition of valuable services they have rendered to the Club and to science, viz: Prof. H. F. Wickham, of Iowa State University, and Mr. Theodor Holm, Assistant Botanist of the Department of Agriculture, Washington, D.C.

A special prize was offered by the Hon. G. W. Ross, Minister of Education, to the student of the Normal School doing the best work in Natural History in connection with the Club's work. The prize was awarded to Miss Elma Cannon, of Athens, Ont., for the best collection of botanical specimens made during the season. A second prize was given by the President, Dr. Ami, and was awarded to Miss May E. Robson, of Grey Co., Ont.

A memorial portrait of the late Elkanah Billings has been presented to the Geological Survey Department by a committee of the Club, as recorded in the OTTAWA NATURALIST for January last.

The hearty thanks of the Club are again due Dr. J. A. MacCabe for giving the use of rooms in the Normal School for our library and for holding Council meetings, and for the use of the Assembly Hall and lantern on two evenings. We have also to acknowledge our indebtedness to the Young Men's Christian Association for the free use of their Assembly Hall for ordinary meetings; to Mr. D. B. Dowling, Mr. Putman and other gentlemen who assisted in operating the lantern at different lectures, and to the daily newspapers for inserting notices of our meetings.

HENRI AMI,
President.

W. J. WILSON,
Secretary.

TREASURER'S REPORT FOR THE YEAR 1900-01.

To the President and Members of the Ottawa Field-Naturalists' Club.

The Treasurer begs to report that the finances of the Club are in a satisfactory condition. It will be seen by the statement submitted herewith that about 225 members have paid their subscriptions. The advertisements realized a little more than last year, and the Treasurer wishes again to speak emphatically to the members of the Club of the duty we owe to those firms who help us every year by advertising in THE OTTAWA NATURALIST. It will be seen by examining the list of firms who advertise with us, that they are all first-class houses, which will supply goods at least equal in quality to those obtainable anywhere else, and it is only reasonable that these firms should expect to receive an increase of business from the members of the Club, whose interests they serve by advertising in the Club organ. I am quite well aware that many members of the Council do make a point of dealing with these firms, but I believe even more can be done by other members of the Club. For my own part, I always make a point, occasionally even at some little inconvenience, to deal with those who have shown a substantial interest in this Club because it is in an organization in which I am keenly interested. Most matters in this world are arranged on a *quid pro quo* basis, and I leave this matter with the members of the Club, asking them to bear it in mind.

THE OTTAWA NATURALIST has contained many valuable papers, several of which were well illustrated. The printers have done their work satisfactorily, and the cost of the monthly magazine, including illustrations, extras for authors, postage and editing, has amounted to \$400.16. Miscellaneous printing has cost \$24.55. The conversazione and soirée expenses have this year cost us only \$10.82, and there is now a satisfactory balance on hand of \$256.46. From this a small amount must be deducted for illustrations which have been ordered but have not yet been received.

Your obedient servant,

JAMES FLETCHER,

Treasurer.

N.B.—All subscriptions are payable in advance, and are due each year on the day of the annual meeting.

—We patronize our advertisers.—

THE OTTAWA FIELD-NATURALISTS' CLUB.

The Treasurer's Statement for the year ending March 19, 1901.

RECEIPTS.		EXPENDITURE.	
1900.		1901.	
March 20.—To balance	\$146 30	March 20.—By print- ing OTTAWA NATUR- ALIST, Vol. XIV.	\$256 90
Subscriptions, 1900-01	\$136 50	Illustrations	39 40
„ „ arrears	89 00	Authors' extras	33 90
	225 50	Postage and wrapp- ing	19 06
Advertisements	76 10	Editor	50 00
Extras sold	21 30		400 16
OTTAWA NATURALISTS sold	3 70	Less 5% allowed on printing a/c \$297 05	15 15
Government grant	200 00		385 01
Profit on excursions 1 and 2	11 80	Miscellaneous printing	18 95
Electrotypes sold	8 00	Programmes	2 00
		Receipt books	3 60
		Stationery	24 55
		Conversazione expenses	10 82
		Typewriting of report	2 00
		Telegram	31
		Postage	5 80
		Loss on excursion 3	5 15
		Exchange on drafts	35
		Balance in Bank	256 46
	\$692 70		\$692 70

Audited and found correct.

J. BALLANTYNE,	} Auditors.
R. B. WHYTE,	

JAMES FLETCHER,

Treasurer.

THE LATE DR. G. M. DAWSON, C.M.G., F.R.S.

The Ottawa Field-Naturalists' Club here places on record an expression of its deep sense of sorrow and loss at the death of Dr. George M. Dawson, C.M.G., F.R.S., F.G.S., F.R.S.C., &c., Director and Deputy Head of the Geological Survey of Canada, who was President of the Club for the years 1892, 1893 and 1894.

By his death Canadian science loses one of its most brilliant and distinguished leaders; one who by his varied intellectual gifts and ceaseless labours substantially advanced the scientific and material interests of the Dominion during the last quarter of a century.

NATURAL HISTORY IN YUKON TERRITORY.

A letter has been received from Mr. J. B. Tyrrell, now living in Dawson City but formerly of Ottawa, and who has published several very valuable papers in THE OTTAWA NATURALIST, stating that Mr. William Ogilvie and some of the other residents of Dawson are making an effort to start a Yukon Museum in which all the natural products of the country are to be represented:—rocks, minerals, plants, animals, birds, insects, etc. The local Government is much interested in the undertaking, and a building has been promised for this spring.

Mr. Tyrrell has been chosen as curator for the time being, and there is no one in the Yukon so well fitted to fill this post. Mr. Tyrrell's long experience as a traveller and collector, and in the Museum while on the staff of the Geological Survey, will enable him to do most valuable service in organizing and starting the work at the outset in a systematic and useful manner.

J. F.

BOTANICAL NOTES.

RATTLESNAKE PLANTAINS. *Goodyera repens*, supposed to be a common plant in the vicinity of Ottawa, is not represented among the specimens so named which I have seen. *G. tessellata*, *G. repens* var. *ophioides* and *G. pubescens* have all been collected within the area covered by the Club's work. The true *G. repens* is a northern species and may yet be found in the Gatineau Valley. *G. Menziesii* may also be found here as it has been collected in New Brunswick, Quebec and Western Ontario. A revision of this genus was published in *Rhodora*, Vol. 1, No. 1.

ASTER VIMINEUS. We have in the vicinity of Ottawa both *A. vinimeus* and the variety *saxatilis*, Fernald. The variety is a slender plant and easily separated from the species by its stiff, ascending branches terminated by a solitary head. It has been collected at Paugan Falls and Casselman.

J. M. M.

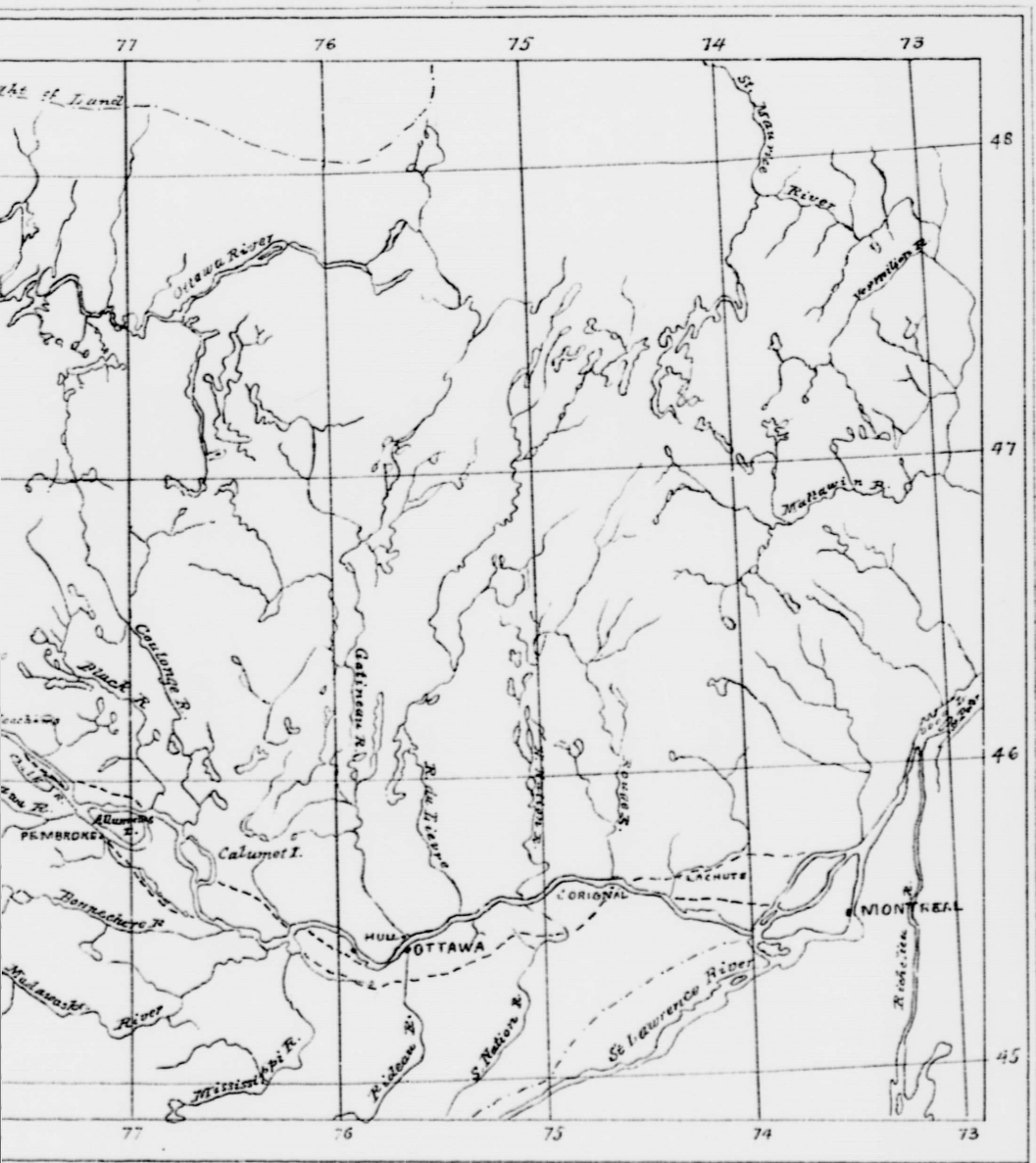
BIRD NOTES FROM POINT PELEE, ONT.

By HARRY GOULD, London.

(Read before the London Ornithological Section of the Entomological Society of Ontario.)

Point Pelee, in Essex County, is a narrow spit of land jutting out into the lake at the west end of Lake Erie. It is interesting in many ways; looking at it from Leamington, about 12 miles distant, one might imagine that a huge Cleopatra's needle had ages ago toppled over and was now lying on its side with the tip stretching out into the lake. Judging from the chips of flint and other indications this point was in times gone by a favourite resort for Indians. Fish and game of all kinds would be plentiful and it is known that many years ago a number of whites were murdered here by the red-skins for the sake of their belongings. It was not, however, to study the archæology of this interesting locality that my friend Mr. W. E. Saunders and I visited it on Sept. 19th and 20th 1900, but on account of it being such a favourable place for the crossing of birds during migration. There is perhaps nothing so interesting in connection with the study of our native birds as their arrival in spring and departure in autumn. We listen with delight in early spring to the first sound of the Bluebird or Robin and with sadness in the fall, to the chirp of the little bird over head at night as he seems to say good bye. Point Pelee is 10 miles from the base to the tip and 4 miles across the base, from which it gradually tapers the whole distance to the tip. A great part of the base has a government ditch or dyke running through it rendering it very good farm land. On the east side towards the tip is a marsh which is rented to a gun club for duck shooting, but on the west side is natural wood-land, which gets more stunted in growth as the tip is approached. Across the lake to the west, about 8 miles distant, is Pelee Island and further south are several smaller islands called the Sister Islands making it a very easy passage for birds crossing the lake into Ohio. With all these advantages it is only natural to suppose a great many of our birds cross at this particular point. Upon the evening of September

19th last Mr. Saunders and I arrived at Leamington about 7.30 p.m. and started on our tramp by going about 5 miles towards the lake on the east side of the point and camping for the night near the road in a little wood where our first bird the Great Horned Owl was noted, as well as a small bird or two journeying overhead. At daylight we were on the move for the lake shore but before reaching it we saw a number of Marsh Harriers and a small flock of ducks, possibly Black Ducks. Feeding in a weedy patch near the road were a number of Dickcissels. The lake was soon reached and having a nice sandy beach we expected to find waders and gulls. The first to be noted were the Herring, the Ring-billed and Bonaparte gulls, Black-billed, Semipalmated, Golden and Kill-deer plovers, Sanderlings and Baird's Sandpiper. Skimming past the Common and Black Terns were seen. By noon the tramp is beginning to tell and we halt to rest and get dinner. The lake water has to be boiled, and the drifting sand plasters the bread and butter but being hungry everything goes and we are soon off again. In passing the open water of the Marsh we were able by the aid of glasses to identify the Horned Grebe. Evening found us at the point and having walked all day in the sliding sand and thinking that enough was as good as a feast, we camped for the night under a scrubby red cedar. Next morning, breakfast over, a start was made back up the west shore, where owing to the woods we expected to find very different birds; the first specimens noted were a pair of Cooper's Hawks and Sharp-shinned Hawks were to be seen all day while the small birds which they caught napping were many, as was evidenced by the bunches of feathers found here and there through the woods. Warblers were numerous, including Black and White, Black-throated Blue, Black-throated Green, Bay-breasted and Chestnut-sided, also the Black-poll with a few Golden and Ruby-crowned Kinglets. The Gray-cheeked and Olive backed Thrushes seemed to be the favourite food of the Hawks with once in a while a Cuckoo. On nearing Leamington we saw a number of Bald-headed Eagles sailing aloft and on the shore found a number of dead Shad which had been discarded by fishermen. These accounted for the presence of the eagles. A walk of 3 miles back to the train at Leamington finished a very pleasant two days outing.

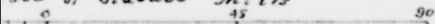


MAP OF THE OTTAWA RIVER BASIN

Showing

D PRE-GLACIAL CHANNELS

Scale of Statute Miles



ANCIENT CHANNELS OF THE OTTAWA RIVER.

By R. W. ELLS, LL.D., F.R.S.C.

The Ottawa may well be regarded as one of the great historic rivers of Canada. For hundreds of years it formed the favourite means of communication between the Indian tribes of the west and those of the east. It was ascended by Champlain in 1615. At that early date he crossed the height of land at Lake Nipissing, and was presumably the first white man to gaze upon the vast expanse of our inland seas.

Following the advent of this great explorer, this river became the chosen route of the voyageurs on their way inland to the great unexplored country of the western plains. On the coming of the Hudson Bay Company it formed the principal channel for carrying on their immense business, their brigades of boats and canoes passing year by year, carrying eastward the annual harvest of furs and bearing westward into the wilds of our vast interior the various kinds of merchandise suitable to the trade with the savages of the great west. Later, by means of steamboats on the deep stretches and by portages round the falls and heavy rapids, it formed the chief means of communication between the east and the numerous settlers who were scattered along its route.

The river itself is of very ancient date. When the continent was young, its valley was outlined, and for countless centuries the drainage of a large part of eastern and northern America followed approximately the present course. In support of this statement it may be said that along the present channel of the stream, extensive deposits of the oldest Palæozoic formations of this part of Canada are found, ranging from the base of the Potsdam sandstone upward into the Silurian, comprising many hundreds of feet of strata, the greater portion of which, over many thousands of square miles, has long since been removed by the various processes of denudation.

The finding of these formations at many points in the bed of the present channel shews that, before they were deposited, the granite and gneiss hills were formed and the principal river channels

South Nation which rises near the St. Lawrence not far from the town of Brockville, and after a somewhat tortuous course of 100 miles reaches the Ottawa about forty miles east of Ottawa city. The descent of the river in this distance is not more than 100 feet, so that, allowing for the High Falls near Casselman and several rapids between that place and the Ottawa, it will be seen that for the greater part of its course the waters of the South Nation must be comparatively sluggish.

The elevation of the height of land to the north which divides the waters of the Ottawa from those flowing into James' Bay is rarely more than 1,000 feet above sea-level. Over a large part of this area to the north, embracing many thousands of square miles in this direction, the surface is covered with heavy deposits of sand which overlie thick beds of clay. These deposits extend from the lower Ottawa and the St. Lawrence nearly, or in places quite, to the height of land. In the absence of fossils in these higher clays positive evidence of their marine origin cannot be obtained, but it may be stated that they are continuous northward with those which do contain such organisms, and therefore the assumption may be made that the sea, at some date prior to or at the time of their deposition, had invaded all the northern country to a depth of some hundreds of feet.

The denudation of the old crystalline rocks, which were the first to appear throughout this area, must have been enormous. How many thousands of feet have thus been removed, cannot be surmised. But along portions of the lower Ottawa, as in the stretch below the Joachims Rapids, known as the Deep River, the present bottom of the channel is now many feet below the sea-level, the surface of the river being about 370 feet above tide, while soundings made several years ago are reported to have reached a depth of over 500 feet.

In Lake Temiscaming also, certain portions have been sounded and show that here the excavation has been very great. At one point a depth of 470 feet was obtained, while the surface of the lake is 591 feet above the sea. There must therefore have been a large amount of denudation throughout this part of the old river basin, though certain parts of this old channel have since been to a certain extent filled in by glacial deposits.

It is interesting to note that, as one ascends the Ottawa, the lower beds of the Palæozoic series fail to appear. Thus, in the lower portion of the river and as far west as the foot of the Chats Falls about thirty-five miles west of Ottawa, the lowest formation of the series, viz., the Potsdam sandstone, rests directly upon the Archæan rocks. This is succeeded upward by the higher members of the series. But even in early times there must have been heavy breaks and uplifts, since, on the crest of the ridge of crystalline rocks which extends eastward from Arnprior to within a few miles of Ottawa on the south side of the river, a deposit of the Potsdam sandstone is seen several hundreds of feet above the beds noted near the river bank at Quyon, while a couple of miles further south, this part of the series has been thrown down again by a heavy break, to about the same distance.

West of Arnprior the lowest beds seen along the river are of Calciferous age, and these are last observed at the west end of Allumette Island, above which no outcrops of this formation have yet been recognized.

Further up the river, above the Roche Capitaine, which is thirty-six miles below the Mattawa, the lowest beds are of the Chazy formation, while on several of the islands in Lake Nipissing beds of Black River age are found. On some of the islands in the northern part of Lake Temiscaming fossiliferous limestones of upper Silurian age occur which are about the horizon of the Niagara formation. The Black River beds of Lake Nipissing are at nearly one hundred feet greater elevation than the Niagara beds just mentioned, and about 100 feet lower than similar limestones seen in the vicinity of Clear Lake to the south of the Bonnechère.

In all descriptions of the country toward the height of land, north of the Ottawa, the occurrence of great areas of sand has been pointed out. The origin of this sand deposit has never been satisfactorily explained. The material appears to be largely the result of the decomposition, or breaking down to a fine state, of the underlying granite and gneiss which are the predominating rocks of the area. From the generally level character of the country along this height of land isolated peaks rise to considerable elevations, though over long distances these are rarely more than low hill features, scarcely exceeding a hundred feet in height, above the general plain.

It is scarcely to be supposed that the decay of the granitic rocks alone could give rise to the extensive deposits of clay which spread over so wide an area of the Ottawa valley underlying the sand. These clays are seen at elevations up to the summit of the dividing ridge, at several points reaching a height not far from 1,000 feet above the sea. The source of this clay must also be largely conjectural. It may be safely assumed, however, that the amount of denudation throughout the entire area has been something enormous. In the Eastern Townships of Quebec this has been undoubtedly more than 1,000 feet. In the area around Ottawa city it has been fully as much, since at the faulted contact of the Calciferous and the Utica the upraised beds have been entirely removed and the rocks reduced to a uniform level. It is quite possible that there was at one time a regular succession of the Palæozoic formations throughout the Ottawa valley, extending over the whole country both north and south to the present height of land, since even now we find at many widely detached points, patches of these rocks which have in some way escaped the denuding agents. It is therefore quite possible that much of the clay throughout the district has been the result of the decomposition of the more recent formations.

While therefore this grand scheme of denudation has been going forward from the earliest times, this has been supplemented by the agency of ice in the glacial period. How many of these periods of glaciation have been in operation in this area we can not say, but we have distinct evidence of at least three which are presumably the most recent, and the traces of other and earlier ones are probably long since removed. That ice moved over the area in different directions and at different times is shown from the direction of the striæ and groovings now seen on the rock surface. The presence of a third and apparently last set of markings with a western trend seems to indicate that a series of large floating ice-pans moved westward up the Ottawa in a direction almost opposite to that recorded for the earliest known glacier which would seem to have followed down the present channel of the river.

In discussing the history of this valley therefore several periods of upheaval and depression must be considered, and some

of these must have affected the surface or crust by a vertical uplift of many hundreds of feet. The amount of the latest recorded movement can be, to some extent, estimated by the present position of certain terraces which occur along the Ottawa and St. Lawrence rivers. These are found at elevations ranging as high as 900 feet above sea-level on the slopes of the mountains east of Montreal, while on the upper Ottawa and around Lake Nipissing terraces are recorded at even greater heights. Thus high level beaches in the vicinity of North Bay were recorded by Mr. F. B. Taylor* at elevations of 1100 to 1200 feet and were regarded by him as of marine origin. Along the Ottawa, below Mattawa, Mr. R. Chalmers records beaches and sand terraces at elevations of 1000 feet and more, and further adds "Extensive deposits of sand and silts, implying submergence are spread over this part of the country up to a height even greater than that of the beaches referred to which have been described in earlier reports of the Geological Survey as Algoma sands*."

These sands were formerly supposed to be due to fresh-water agencies, but subsequent investigation has shewn that portions of the deposits thus styled contain marine organisms, especially along the lower Ottawa, while their similarity in many respects to those which have been styled Saxicava sands in the lower St. Lawrence basin and which are held to be of marine origin, is very remarkable.

While therefore the Ottawa at some time flowed in a tolerably direct line from the mouth of the Mattawa to the St. Lawrence, certain causes have interposed at different periods to deflect the waters from their original course and to cause them to excavate other and newer channels. In an examination of the valley of the river these interruptions will be found at various points. Thus in that portion of the river between the Mattawa and the head of the Deep River, a distance of fifty-four miles, the channel is fairly straight. Several heavy rapids and falls however occur among which may be mentioned Des Joachims, Roche Capitaine, Deux Rivieres, La Trou, L'Eveille, &c.

*Bulletin Geol. Soc. Am., Vol. V, 1893.

*Rep. Geol. Sur. Can., Vol. X, p 18 J.

At most of these the banks are high and the river still apparently follows its original course. At the Roche Capitaine however, and at Des Joachims, secondary channels have been made and the waters diverted. This feature is especially well seen at Des Joachims where the present channel of the river is comparatively new and the course of the old channel lies to the north following the depression occupied by McConnell Lake and coming into the present channel at the head of the Deep River, to the north of the village of Des Joachims in a well defined depression, while the shallow nature of the present channel is indicated by the long line of foaming rapids which come in from the south. The difference in elevation between the foot and the head of these rapids is about forty feet. It is probable that at some time in the history of the river, perhaps at the close of the Glacial period, great accumulations of sand, gravel and boulders blocked the old channel at a point some three miles above the present foot of the rapids or near the mouth of the Dumoine river, and thus diverted the stream. Possibly the same thing occurred at the Roche Capitaine, since here the second channel is seen to the north of the large island in the river, this channel being now largely dry at ordinary stages of the water.

Indications of this blocking of the old course of the Ottawa is seen in the great accumulations of boulders near the village of Mattawa, which represent terraces of morainic origin, modified by the agency of the waters of the river. This evidently had some effect upon the river channel at this place, since Dr. A. E. Barlow in his report on the region says that "a well defined old river-channel occurs running through the rear portion of the village between the main street and the railway station which has evidently been followed by the Mattawa or its antecedent stream. It leaves the Mattawa about a mile above its mouth and reaches the Ottawa at the foot of the rapid nearly three-quarters of a mile below"*

About twenty miles west of Pembroke the river makes a sudden bend to the south at what is known as High View. Just above this on the north side is a bold headland known as Oiseau rock, which rises abruptly from the surface of the stream

for a height of nearly 500 feet. The southern shore of the river for several miles above High View is a rocky ridge which divides the Deep River channel from a long chain of lakes which starts from the south shore of the Ottawa about ten miles west of High View and cuts across to a point about three miles south of High View point. The surface of the country around this chain of lakes is heavily sand covered and these deposits extend south towards Chalk River. The lakes evidently indicate a former channel of the Ottawa which became choked up by sand subsequent to the glacial period.

The shore of the river opposite High View is indented by bays. The north shore of the main stream east from Oiseau rock continues in a bold range of hills for some miles eastward, and an old channel apparently followed a straight course from the deep bay eastward from High View. This channel evidently became choked up by great deposits of sand and gravel, thus diverting the stream past the east end of what is now known as the township of Buchanan, southward. The old channel thus blocked extended across the southern part of the townships of Sheen and Chichester, and probably reached the Culbute channel of the the Ottawa which flows along the north side of Allumette Island, below the Culbute Fall.

On both sides of the river opposite this place and for some miles to the east and west, the surface is covered with great deposits of sand and gravel, many feet in depth. In that part of the township of Chichester, north of the village of Chapeau, these sand ridges are well defined, continuing for several miles till they reach the foot of a bold ridge of granite and gneiss. This ridge is continuous from the foot of Deep River to the mouth of Rouge River about sixty miles below Ottawa city, and at one time undoubtedly formed the the north shore of the Ottawa River for this portion of its original course.

A great part of Allumette Island is occupied by these reddish granite sands. They form extensive ridges along the centre of the Island from east to west and they were at one time doubtless continuous with the broad areas north of the Culbute channel through which that channel has since been cut. The upper end of this channel for some miles is narrow and rocky, but the portion below the

Culbute fall is much broader and rocks rarely appear along its course except at the crossing of the road north from Chapais. Below this the shores are of clay or sand till the end of the Island is reached where the Pembroke channel joins the Culbute, flowing over broad ledges of Black River limestone, and forming what is known as the Paquette Rapid which is about a fourth of a mile south of the junction of the two channels.

The Pembroke channel which flows past the south side of Allumette Island is not deep. At the upper end rapids extend partly across the river and there are many small granite islets. Along the south shore of the river especially above the mouth of the Petewawa the banks are entirely of sand and in some places are from fifty to eighty feet high.

At the town of Pembroke a depression comes to the river from the south and the Musquash River here joins the Ottawa. This stream flows north-west against the regular course of the Ottawa and discharges the Musquash and Mud Lakes, the former of which is about ten miles in length. The stream is for the most part sluggish, flowing through a clay flat for some miles. On the north side of Musquash Lake a ridge of crystalline rocks rises abruptly, and on the south side Palæozoic rocks, mostly of Black River age, form outliers, which have steep scarp sides towards the north as if cut down by the agency of running water.

At the upper end of Musquash Lake a stream flows in which discharges a chain of long and narrow lakes, and these continue for some miles in a depression into the township of Horton. Along these lakes, which are surrounded by great masses of sand the action of water is very evident. Some of them are long and very narrow but have a depth of over a hundred feet, though only a few chains in width. They present all the features of an old river channel which has been blocked up by great deposits of sand, gravel and boulders, so that the original channel is now defined simply by the line of the depression and the remnants of the old river left in the narrow series of lakes.

This depression extends out to the river again, reaching it near what is known as the Chenaux rapids, about four miles below the junction of the two channels which surround Calumet Island,

and which join a short distance above the village of Portage du Fort.

Of these two channels the south or Roche Fendu, is very rough and rocky. The north channel from Le Passe around the north end of the island and down to Bryson, flows for the most part of the distance through great beds of sand which show on both sides of the river but are very largely developed on the island, especially on the northwest portion.

Below the Chenaux Rapids the Chats Lake forms the river and extends down to the head of the Chats rapids and Falls about three miles east of the town of Arnprior. The shore on the north side opposite Sand Point and thence to a point opposite the mouth of the Bonnechère River is largely drift covered, and this feature is well seen at Norway Bay where great banks of sand form the shore line for some distance. Inland also these deposits are largely developed to the east of Shawville, where they overlie a great thickness of clay, which extends northward to the main ridge of crystalline rocks.

The Chats Falls are caused by a large dyke of reddish granite which cuts across the crystalline limestone of the Arnprior and White Lake belt, here several miles in width. The falls are among the most beautiful on the river, extending across the whole breadth of the stream which is here about two miles in width. The total rise from the foot of the falls to the waters of Chats Lake is about fifty feet.

Just below the Chats Falls on the south side is the village of Fitzroy Harbour, It is built on a clay bluff about forty feet in height and this rests on the Calciferous dolomite, which in turn reposes on the gneiss and crystalline limestone at the foot of the falls. These newer rocks are seen on both sides of the river.

The Carp river enters the Ottawa a short distance below the village, and has a course of about twenty miles. It also flows westerly against the general course of the Ottawa in a depression through the northern part of the townships of Huntley and Fitzroy and is on the whole a very sluggish stream. About four miles above its mouth there is a rapid formed by a ridge of granite. Elsewhere the bed of the stream is a clay flat, in places very marshy, to its source, which is in the northern part of the township of Goulbourn.

Between the Carp and the present channel of the river, a well defined ridge of crystalline rocks extends eastward from the vicinity of Fitzroy to within nine miles of Ottawa city, where it sinks down nearly to the level of the river and becomes covered over with Potsdam sandstone. The south side of the ridge is marked by a well defined line of fault which brings the Black River limestones against the crystalline rocks. It is supposable therefore that an old channel of the river flowed eastward along the depression in which the Carp River now lies.

To the north of the crystalline rock ridge just mentioned a second line of depression occurs also south of the Ottawa and separated from it by another rock ridge formed of Chazy shale and limestone. In this depression lies Lake Constant, and Constant Creek flows thence westward to the Ottawa into a deep depression known as Sand Bay. The elevation of the Creek and Lake is but a few feet above the present level of the river, the waters being sluggish throughout, and the depression extends eastward through a swampy tract into the Ottawa again at Shirley Bay a few miles west of Britannia. Great areas of reddish sand occupy the shores of the Ottawa about the mouth of Constant Creek and for several miles to the east and west.

The north side of the Ottawa between Hull and a point some miles west of the Chats Falls, practically as far west as the Ottawa opposite the east end of Calumet Island near Campbell's Bay above Bryson, is generally low and largely occupied by great deposits of clay or sand. Occasionally well defined beaches are seen, as in the area to the north-west of Quyon near the village of North Onslow, where they are crossed by the road between these two places. Occasional ridges of rock occur, as in the rear of the town of Ay'mer and north of Bristol station, but the main shore of the river was at one time undoubtedly marked out by the great ridge largely composed of reddish grey granite which rises in Kings Mountain, west of Chelsea, and extends westerly for many miles forming the northern limit of the great Ottawa plain.

The lower part of the Ottawa must have been at one time much broader and more delta shaped than at present. On the north side the range of the crystalline rocks must have defined the river much as at present, as far as the mouth of the

Rouge River, but below this place the hill range trends off more to the north-east and a broad plain occupied partly by sand and largely by clay, extends southward to the St. Lawrence. The northern part of this area is traversed by the North River, which between St. Jerome and the town of Lachute has but little current and follows a westerly course till the latter point is reached when it bends abruptly to the south and meets the Ottawa near the village of St. Andrews, near the upper end of the Lake of Two Mountains.

To the south of the North river and east of Lachute a rock ridge formed of the Potsdam and Calciferous rocks comes in and extends eastward for some miles. South of this a broad well terraced valley extends across to the lower portion of the Ottawa, but this area is again traversed by a granite ridge which rises just to the east of St. Andrews and extends eastward for four to five miles. Between these two ridges the depth of clay and gravel is great. At one point several borings have been made, one of which reached a depth of over 120 feet without touching the underlying rock, so that the bottom of this old channel is many feet below the present level of the river.

On the south side of the Ottawa below Ottawa city, the country between the river and the St. Lawrence is generally level or broken by low ridges, sometimes of rock but often of gravel or boulders which have come from the north side of the Ottawa. Over a large part of this area great deposits of clay, overlaid in places by sands and gravels, are seen, and a peculiar feature of these deposits is noted in the fact that while the clays are undoubtedly of marine origin they rarely show marine fossils, while the overlying sands and gravels contain these in immense quantities at very many places. These marine shells however apparently cease west of a line drawn from Smith's Falls to Prescott or have not yet been noticed in the western area, though there is no apparent break in the character of the surface deposits in this direction.

South of the Ottawa also the evidences of an old river channel are very clear. A large number of borings have been made in the last half dozen years both in the vicinity of the river itself and in the area to the south. Some of these are in the course of the east

and west stretch of the Nation river. The holes were sunk only to the rock in most cases, through clay with occasional thin deposits of sand or gravel. The deepest of these was 210 feet, and in the township of Plantagenet on the north bank of the Nation, and in Alfred about two and a half miles east, two holes were sunk to the underlying Utica, to depths of 180 and 186 feet. On a line extending westwardly along what is known as the Brook in the direction of Eastman's Springs a number of similar holes have been bored, the depths of which ranged from 100 to 150 feet, following a fairly direct line. The most easterly of these was put down at Caledonia Springs to a depth in the clay of 132 feet. Beyond this to the north-east the country is flat and clay covered in the direction of L'Orignal at which point presumably this ancient channel reached the river. Recently in the area south-east of Ottawa city, near Ramsay's Corners, a boring has been made which passed through 186 feet of clay and 18 feet of underlying gravel to the Lorraine shales.

This line of excavation may be the continuation of that already described for the Carp valley, since in the eastern portion of the Carp area there are great deposits of clay, gravel and sand which extend beyond the Rideau a few miles south of Ottawa in the direction of the deep borings just referred to. The old channel should cross the Rideau not far from the centre of the township of Gloucester and extend towards the Mer Bleue, since rock escarpments appear a short distance north of that place in the direction of the Ottawa, and rock ledges are seen to the south in the direction of Bear Brook on the line of the Canada Atlantic Ry.

On the lower Ottawa between Grenville and Lachute the surface is generally flat. Deposits of clay, covered in places with a great thickness of sand, occur in the area between the bold escarpment of the crystalline rocks and the river, and near the line of the Grenville canal the accumulation of boulders over the surface is very great. The whole area for some miles is heavily drift covered, and great masses of ice must have discharged immense loads brought from the high lands to the north and north east in this direction. These accumulations of boulders are found at intervals over a large extent of country south of the Ottawa, some of the blocks being of immense size. Near Vankleek Hill

great numbers of these loose rocks can be seen, one of which measures 20 feet by 15 feet and is 4 feet out of the ground.

Among channels of more recent date but which are now closed except at periods of high water on the river, two at least may be mentioned. East from Coulonge village a depression in the surface extends to the Ottawa at the north west angle of Calumet Island. The eastern portion of the depression to the west of the river is known as the Grand Marais or Big marsh; and while at ordinary stages of water in the Ottawa much of this is comparatively dry, in the spring it becomes a regular water-course cutting off the great point which extends south-west from Coulonge village to La Passe.

Further east below Ottawa at the mouth of the Nation river a depression also occurs forming the bay in front of the village of Papineauville, and separating that place from what is known as the Presqu'île. This latter is a long ridge or tongue of gravel and sand which extends east from the mouth of the North Nation River for about six miles. At high water stages the current passes over the narrow barrier at the west end of the Presqu'île Bay and flows directly past the village. It is quite possible that close investigation in the Ottawa basin would disclose other channels which are now partly filled.

In this paper it has been the intention to indicate only the most prominent of these old channels. That the submergence of the whole basin has been sufficient to cause the waters of James Bay to unite with those of the Ottawa basin is indicated by the presence of well defined terraces and clay deposits at elevations greater than the present height of land north of Lake Temiscaming. It is probably due to this great spread of inland or ocean waters over this area that the sands and gravels which have been so instrumental in choking up the ancient valley of the river are so widely distributed. That these upper level deposits of clay and sand have not yielded organic remains is only negative evidence against this theory. On similar grounds much of the typical marine clay of the Ottawa and St. Lawrence basins would not be of marine origin since in the whole stretch north and west of Ottawa city they yield marine fossils only in very rare cases.

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