No. 2 1899-1900

TRANSACTIONS

OF THE

Ottawa Literary and Scientific Society

PRICE 50 CENTS

OTTAWA:
THE ROLLA L. CRAIN & CO., LIMITED, PRINTERS
176-178 WELLINGTON ST.

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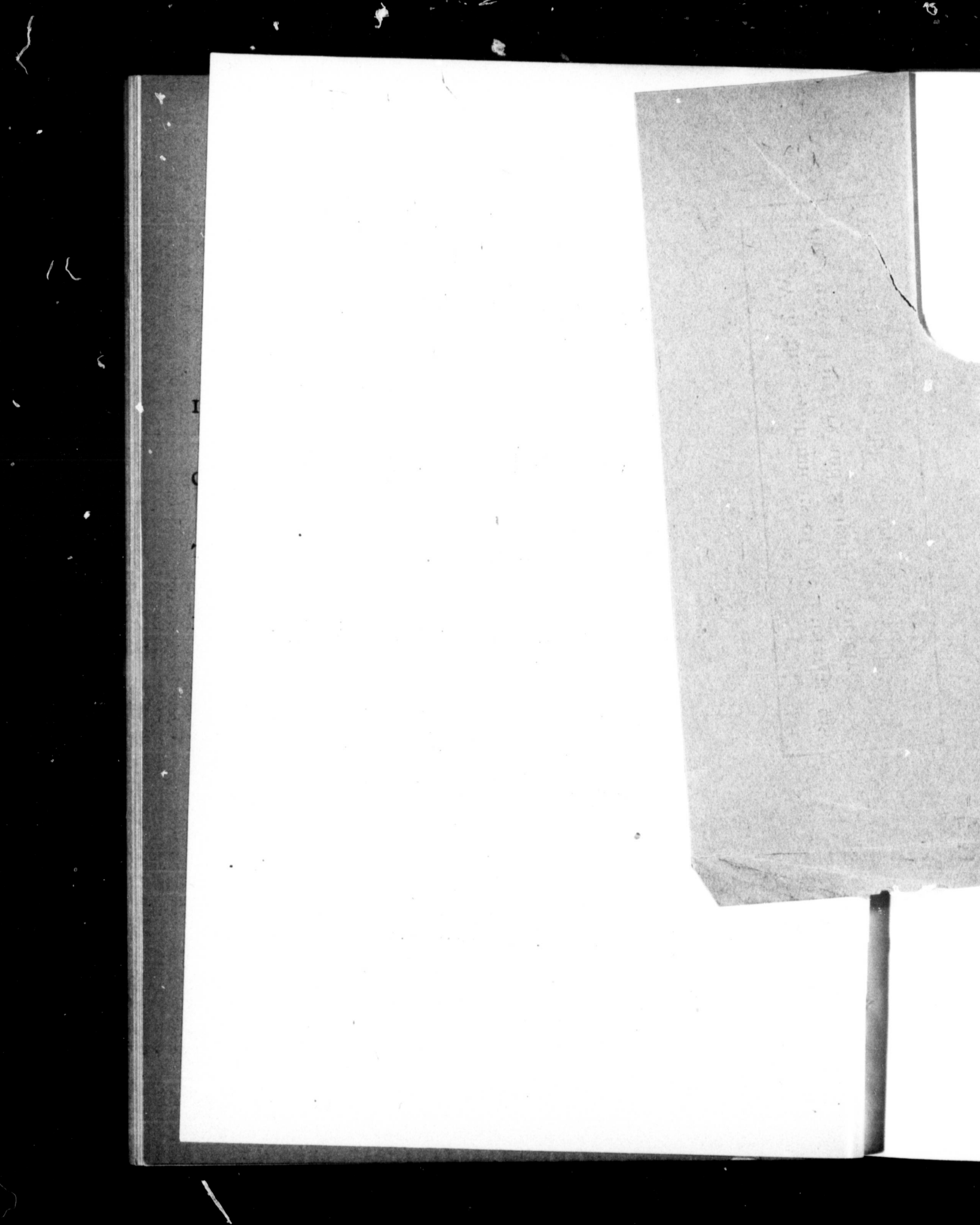

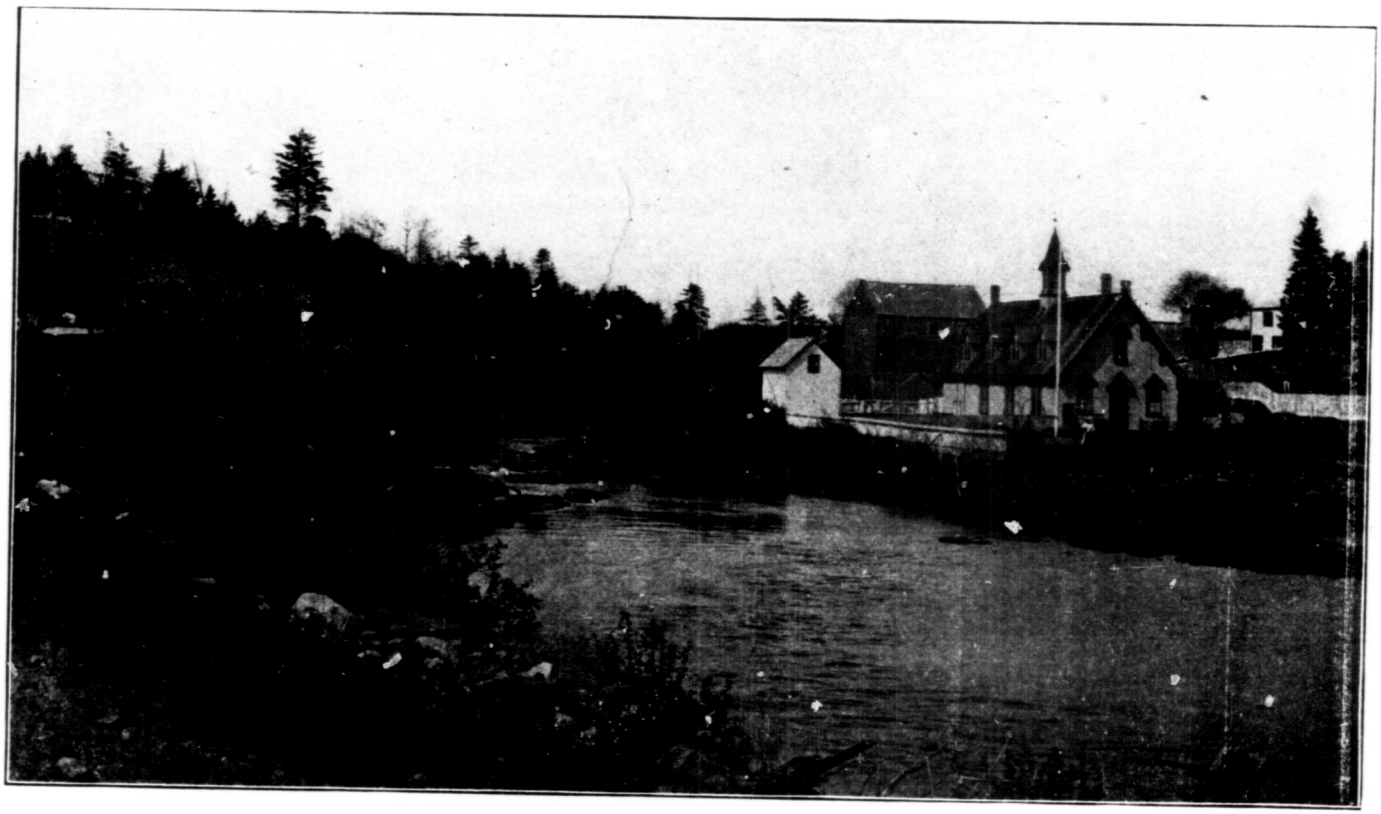

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TRANSACTIONS

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Ottawa Literary and Scientific Society.

INTRODUCTION.

When the first number of the Transactions of the Ottawa Literary and Scientific Society was published, the series of papers which it contained was prefaced by a concise and very appropriate introduction by my predecessor in the Presidental Chair, Mr. Otto Klotz, who so clearly stated the *raison d'etre* of this publication that any words of formal introduction to the present pages might well appear superfluous.

The days of lengthy introductions, of formal preludes and prologues are, indeed, over as Dr. John Skelton has warned us in his delightful "Table-Talk of Shirley." The genial Edinburgh *litterateur* did not shrink, however, from expressing a word of commendation for the well-nigh obsolete formality. ———'As youth', he said 'is glorified by the pleasure of anticipation, so the prologue to poem or romance, nay, even the prospectus of a limited company, has something of the same attractive uncertainty."

Without attempting a repetition of the purpose and aims of this publication, already outlined in the introduction by Mr. Klotz referred to, it is enough to point out that the papers in the present number range over a varied field, literary and scientific. The contributions are original, and were prepared for, and read before, the Society. They represent not so much the popular and entertaining side of the Society's work, as that more technical and substantial side, to which special importance has always been attached by those who have had the administration of the Society's affairs at various stages of its history.

It is a worthy ambition for any society, not merely to take a leading part in the educational work of the capital, to foster and encourage among the citizens a taste for intelectual pursuits, but to endeavour to add year by year to the sum total of human knowledge. A means of publication, such as is afforded by these Transactions may, indeed, prove an incentive to original investigation by members of the Society. To many it has been a matter of surprise that so much new and original matter, as evidenced in the former and in the present number of the Transactions, is available in the form of written contributions by members of the Society and others. To some, perhaps, this fabric of original work in literature, science, art, and other fields, may not appear very ambitious or imposing. Abraham Cowley cherished the desire to build a house—only a small fabric in a large domain, but it was to be an original structure, his own building. This may be claimed for the contents of the present publication that they embody matter specially prepared for the Society, and in most cases wholly new and hitherto unpublished; but it must not be forgotten how wide is the field for original research, how vast the domain that invites exploration. The publication of these Transactions will be amply justified if they embody contributions, of an original and substantial character, in the extensive field of Canadian literature and science.

As an indication of the scope and character of the Society's work, the programme of lectures, papers, &c., arranged for the Sessions 1898–99 and 1899–1900, are printed below.

1898—1899

Dec. 9.—Literary Evening.

1. Introductory Address by the President.
2. Literary Essay by J. Francis Waters, M. A., Subject : "Demosthenes on the Crown."
3. Poetical Readings by W. Wilfred Campbell, F. R. S. C.
4. Literary Essay by W. D. LeSueur, B. A., Subject : "The Masters of English Prose."

Dec. 16.—A. McGill, B. A., "A Study of Browning's Paracelsus."

Jan. 6.—Professor E. E. Prince,

"Four Latter Day Poets."

Jan. 20.—R. W. Shannon, Esq.,

"Wordsworth."

Feb. 3.—Alfred A. Dion, Esq.,

"Electricity with Demonstrations."

Feb. 10.—Rev. A. B. Walkley,

"The Poets of our Land."

Mar. 3.—John Henry Brown, Esq.,

"Walt Whitman—Poet and Seer."

Mar. 10.—Professor James Mavor,

"Imperialism versus Civism."

1899—1900

Nov. 17.—Prof. E. E. Prince,

"The Scottish Schubert—Dr. John Park."
With vocal and instrumental illustrations.

Nov. 24.—J. M. Macoun, Esq.,

"The Canadian Wood-Pulp Industry."

Dec. 1.—Rev. Dr. Rose,

"The Gulf Stream of Literature."

Dec. 8.—F. H. Gisborne, Esq.,

"Dean Swift and his work for Ireland."

Dec. 15.—S. B. Sinclair, Esq.,

"The Golden Mean of Wealth."

Jan. 12.—George Johnson, Esq.,

"Our Northern Fringe."

Jan. 19.—"Is our Age really progressing?" A symposium to be opened by Rev. A. B. Walkley.

Jan. 26.—Leon Gérin, Esq.,

"The Hurons of Lorette."

Feb. 9.—W. D. LeSueur, Esq.,

"The Making of Language."

Feb. 23.—"The Limitation of Municipal Industries." A Symposium to be opened by Members of the Social Science Club.

Mar. 9.—R. F. Stupart, Esq.,
"Earthquakes and the Seismograph."
With Lantern Slides.

Mar. 23.—A. McGill, Esq.,
"Ground Water Wells."
With local illustrations

Otto J. Klotz, Esq.,
"Local deflections of the Plumb-line."

Prof. E. E. Prince,
"Fish Culture in Canada."

E. E. PRINCE,
President.

CANADA'S NORTHERN FRINGE.

By George Johnson, F. S. S. (Hon.)

I

We have in Canada, a region of unknown area, Surveyor-General Deville having made no attempt to ascertain the number of square miles of land surface it contains.

It is an out-of-the-way region. We scarcely think of it when we use the word "Canada." It is not mentioned in Parliament once a session. It suggests no scandals, no award of contracts, without or with tender. Mr. Tarte's dredges are not in demand there. Mr. Blair's engineers are not in request for either canals or railways. Sir Louis Davies is not called upon to provide light-houses and automatic fog-horns, nor is Mr. Fisher solicited to supply hot or cold storage for the products of its orchards and its dairies. Sir Charles Tupper and Mr. Foster and Mr. Fielding are not needed to keep watch and ward over the Treasury-chest to guard against cunningly devised assaults upon the people's money by the people of this region. Mr. Borden had not to decide in October and December last how many volunteers to apportion to it as its share of the gallant 2000 who went, our pledge of Empire, at the call of the Empire, more than 7,000 miles over oceans dreary waste to represent us on the blood-stained field of South Africa. Yet this region has been the scene of great activities. It has been a favorite camping ground for scientists. It has had its free theatres, its free newspapers, its free schools, its own currency. For good work done within its borders it has given more C. B's and K. C. B's and G. C. B's to Britain's sons than any other Province of Canada. It has been a hot-house for growing Rear Admirals, Vice Admirals, Admirals and Admirals of the fleet. It is Canada's Westminster Abbey—one of the grandest temples on earth—"a temple not made with hands"—with more commemorative tablets than has the great temple of silence and reconciliation on the banks of the Thames with its accumulated monuments of over 700 years.

What the Holy Land was to Europe in the time of the Crusades—a field for the adventurous, a training school for the soldiers of Christianity—that this corner of Canada has been to the Mother-land. Among it's thousand isles and straits, the seamen of the United Kingdom have received training to develop caution, dash, intrepidity, individuality, coolness in time of danger, determination undismayed by defeat and all those masterful qualities which are the hall-mark of the British national character.

The greater portion of this region is included in that part of Canada where the lines of longitude converge so that a degree of latitude is from 21 to 10 miles in length instead of the 60 miles on the equator or the 44 miles on the latitude of Toronto.

This region is a region of islands. They have been won for

"The flag that has braved a thousand years
The battle and the breeze,"

by a series of sea-fights with storm and tempest, ice-bergs, and ice-floes, carried on during many years under most unusual and trying conditions, by seamen, "the bravest of the brave."

Canada is essentially a hero-land. There was much of the stuff of which heroes are made in the men who sailed up the St. Lawrence River and won the region of its Great Lakes for the coming generations during the period in our history when the policies of concentration and of expansion first strove with each other, like Jacob and Esau in their mother's womb—the first to confine population to the lower St. Lawrence, and the other to spread over the interior the posts of war and of trade*. The story of the struggles of French and English with the savages of the forest is diamond-pointed all over with deeds of heroism. The long-drawn-out contest of the French with the Five Nations—those Boers of the past centuries ; the march of Frontenac into their country ; the momentous fight of Dollard and his 16 consecrated companions with the Iroquois ; the repulse of Pontiac by Gladwyn when that great warrior, chief of the Ottawas, besieged Detroit ; the fiery career of Sieur d'Iberville,—these and scores of

*See Parkman's "Half Century of Conflict."

others like them all attest that when French were fighting Indians and when they were fighting English, when English were fighting French and Indians, there were among English, French and Indians, heroes in plenty. "Troops of heroes undistinguished died" in the winning of Canada for civilization. We are only now beginning to appreciate at their true worth the pioneers of Canada. The United Empire Loyalists who passed the early years of their life in Canada encompassed with trials, cheerfully borne and successfully overcome, that would have daunted all but men and women cast in heroic mould ; the pioneers who entered each of the 45 counties into which Ontario is divided and by painful processes hewed out the farms from the forest and lived noble lives in lonely log huts scantily furnished—of these it has been said and truly "no better stuff stood beside Nelson on board the 'Victory', no better stuff climbed the heights of Alma or charged the Dervishes at Khartoum" and we may add 'or plunged into the pitiless storm of shot and shell on their resistless way up the precipitous sides of Elandslaagte, or swept their brave foes away along the banks of the Modder River."

The islands of our north have had their heroes, too, and the seamen who won them for the Empire and for Canada are the peers of those who toiled and were martyred along our southern borders.

The general name by which these islands are known is "District of Franklin."

They are appropriately so named in honor of Sir John Franklin, whose exploits in circum-polar regions and whose tragic fate are fittingly commemorated by a monument in Westminster Abbey, by a marble slab prepared under the direction of Lady Franklin and erected in 1851 by Captain McClintoch on Beechy Island ; and by Sir John Macdonald's selection of the great explorer's surname as the official and distinctive appellation of our Arctic Archipelago.

HOW DID IT BECOME OURS TO GUARD AND KEEP FOR THE EMPIRE?

It was transferred to Canada when the North West Territorities were handed over to our care to develop and make the great wheat-raising country it is destined to become, thus solving

the problem ever pressing upon the heart of the British Empire, viz.: How can we supply our food-wants within the Empire itself? Doubts having been expressed by Hon. David Mills in 1878* about the inclusion of the Islands of the Arctic Archipelago in the transfer on the 23rd June 1870, a second Order-in-Council, at the instance of the Parliament of Canada, was passed by the Imperial Privy Council, dated 31st July 1880, by which instrument all the islands were made over to Canada from 1st Sept. 1880† ; thus making assurance doubly sure.

The district of Franklin was constituted and the name conferred by an Order-in-Council of the Canadian government in October, 1895. A subsequent Order-in-Council modifying the allotment of territory was passed in December, 1897, two peninsulas connected with the mainland being added.

WHAT DOES FRANKLIN INCLUDE? WHAT ARE ITS METES AND BOUNDS?

Leaving Hudson Bay out there is the great sea called Baffin's Bay with its northern connections, to the Paleocrystic‡ Sea, of Smith's Sound, Kennedy and Robeson Channels, and its western openings of Jones Sound and Lancaster Sound. Parallel with Baffin's Bay is Fox Channel, connecting by the Fury and Hecla Straits with the Gulf of Boothia, also parallel to Baffin's Bay. The Gulf of Boothia connects by Prince Regent Sound with Barrow Strait which is a continuation of Lancaster Sound running east and west. The western development of Barrow Strait is the expansion called Melville Sound with lateral openings north and south. The northern side openings are Wellington channel, Queen's channel and Penny Strait, these three being prolongations of each other ; and Byam Martin Channel ; on the south side the openings are Peel Sound, Franklin Strait, McClintock

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*Hansard, May 3rd, 1878.

†See Statutes of Canada 1880-81, Impl. Despatches of Orders-in-Council, page IX.

‡Paleocrystic, consisting of ice that does not melt in summer but exists from year to year. First applied to the northermost ice floes encountered by Capt. Markham's party in 1875-6.

Channel, Victoria Straits, Prince of Wales Strait. The Northwesterly extension of Melville Sound is McClure Strait, connecting the Sound with Beaufort Sea and connected with the Paleocrystic Sea of the north by Kellett Strait, Crozier Channel and Fitz William Strait. The Beaufort Sea is connected with Boothia Peninsula along the continental north line of coast by Dolphin and Union Strait, leading into Duke of York's Archipelago and Coronation Gulf ; by Dease Strait from Coronation Gulf to Victoria Gulf ; by Simpson Strait leading to Rae Gulf and the juncture of Boothia Peninsula with the rest of the continent.

The general appearance is that of a fish's back bone, comprising Lancaster, and Barrow Straits, Melville Sound and McClure's Straits with lateral straits on either side. It is like Bank Street with Sparks, Queen, Albert and Slater and other cross streets. It suggests a greater Venice with ice or water streets in every direction but principally north and south. It is a miniature British Empire with the straits for streets just as the British Empire has the seas for streets.

On the far northeastern side of this mighty archipelago and on the western side of Smith, Kennedy and Robeson Channels are Grant Land (bordering on Lincoln Sea), Grinnell Land immediately south of Grant, Arthur Land, Schley Land, Ellesmere Land and N. Lincoln.

Crossing Jones Channel we see North Devon, Victoria Archipelago, Cornwallis Island, North Cornwall, Bathurst Land, Melville Island and Prince Patrick Land lying north of the great central west and east street of the hyperborean Venice ; on the south side beginning at the west there are first, the great island of Banks Land ; then the still greater island named at the north Prince Albert Land, on the west Wollaston Land and at the south Victoria Land ; then across McClintock Channel, Prince of Wales Land ; North Somerset, Prince Regent Island, Cockburn Island, Possession Land and Baffin Land with its appurtenant divisions, Fox Land, Meta Incognita and Cumberland, and its islands, Salisbury, Charles, Mill and Nottingham.

We have completed the round and have only to mention (1) Melville Peninsula to which Capt. W. E. Parry refers as "the huge peninsula situated like a bastion at the north east angle of Amer-

ica," which he named Melville Peninsula in honor of Viscount Melville, then first Lord Commissioner of the Admiralty. Separated from Melville Peninsula by the Gulf of Boothia and stretching far into the north is the last of the great lands of the District of Franklin. It is (2) the Peninsula of Boothia, jutting up north among the islands to the 73rd degree and forming the most northerly part of the mainland of this continent.

The flag was displayed and possession taken of the different parts of the Arctic Archipelago at different times and by different men.

Frobisher and Davis took possession of the islands on the north side of Hudson Strait. Baffin took possession of Elesmere Land and all the tract of land stretching far to the north and ending with Grant Land.

Parry took possession of the northern islands along Barrow and McClure Straits. Belcher took possession of North Cornwall, McClure of Prince Albert Land ; James Ross of Boothia ; Parry of Melville Peninsula. Some of the islands were taken possession of by several persons, one navigator raising the flag at the west, for instance, another at the north, and a third at the south, further explorations showing that the land thus secured belonged to the same island.

Possession was assured in different ways. Frobisher took possession of the south eastern land of the District of Franklin in 1578, more than three centuries ago, by ascending a high hill which he called Hutton's Headland, after one of Queen Elizabeth's favorites and there erecting a large cross of stone in token of christian possession.

The ceremony of taking possession as performed at a latter date is thus described by Dr. Armstrong, the occasion being the taking possession of Baring Land by the Captain of the "Investigator" :

"Having advanced slowly during the night, at 8 a. m. we had reached within two miles of the magnificent headland (which they named Lord Nelson Head, in honor of England's famous sailor) and could obtain no soundings in 120 fathoms of water. Preparations were at once made for landing and taking formal

possession of it in Her Majesty's name. Accordingly Capt. McClure and myself left the ship in the third whaleboat followed by Lieut. Cresswell and as many officers as could be spared in the first cutter. The morning was cold but with a fine clear atmosphere and a fresh breeze from the north-east and with joyful hearts we pulled towards the shore. As we approached we found the ice still packed on the shore so that we were obliged to get out and haul the boat over the floes into clear water which led us on to a fine pebbly beach eastward of the cape, extending out for some distance and it could be distinctly seen to be of great depth from its perfect transparency."

"On landing we unfurled a red ensign and planting the flagstaff in the soil took formal possession in the name of our most gracious Sovereign with three hearty cheers and one cheer more, bestowing on our discovery the name of Baring after the first Lord of the Admiralty under whose auspices the expedition had been fitted out. A scroll containing the ship's name and those of the officers, &c., was placed in a bottle and carefully secured in a cask fixed in the soil, with a pole fifteen feet high attached, to attract the attention of any subsequent visitors to Baring Land. The appearance this bold headland presented while we approached the shore in the boat and when viewed in profile was exceedingly fine. Indeed I may state that its sublimity and grandeur were only equalled by its picturesque beauty, producing an effect I have seldom seen surpassed and recalling forcibly to mind, but on a scale of greater magnitude, the finest of our old gothic structures and castellated mansions according as its position varied with our progress." The headland thus described was 850 or 900 feet high and gives an idea of the character of the scenery of the land to which tourists of the future may go to spend their holidays.

HOW DID OUR ARCTIC PROVINCE BECOME GREAT BRITAIN'S SO THAT THE SUZERAIN HAD POWER TO TRANSFER IT TO CANADA?

Boyd Thacher says "When we study the first westward sailings of hardy English navigators we are only reading the title deeds of our beloved country."

This is true of all North America. It is emphatically true of Canada, and most emphatically true of the Northern fringe of this portion of the British Empire committed to our care by solemn instrument bearing the signature of our beloved Queen.

In order to answer the question asked let us study for a while the "sailings of the hardy navigators."

From a very early date circum-polar regions exercised a peculiar fascination over the men of the European races. From Pytheas to the Duke of the Abruzzi ; from 323 years before "bright-harnessed angels sat in order serviceable" around the Babe of Bethlehem to this year of grace 1900 more than 170* sea-voyages and land journeyings and one balloon trip in high latitudes have been undertaken by different nations, by navigators sailing now in a westerly, now in an easterly course, or by explorers pressing northward over land, now gliding smoothly down the liquid highways of the wilderness, now running rapids and portaging cataracts, either in search of new whaling grounds and of polar water communication, or for the purpose of wresting from the frozen north its ice-imprisoned secrets of climate, of mineral wealth and ocean life.

Danish, Dutch, Spanish ; Italian, Greek, Swedish ; English, Scotch, & Irish ; French, Icelandic, Norwegian, Portuguese, Russian, Venetian ; Canadian and Unistoniam† explorers by sea and by land, during more than 20 centuries have taken part in these attempts to make the Lady of the Iceberg throne and the snow diadem their obedient vassal.

In lordly ships, strengthened and braced by every mechanical contrivance ; in barks of small tonnage, in pinnaces that were the veriest cockle-shells ; in canoe and kayak ; in clinch and shallop, and bomb and pink ; by dog-train and by that most ancient of all methods of transportation, "shank's nag" frequently called the "marrow bone stage" ; with store-room sometimes provided for years of sharp onslaught, sometimes empty as the cupboard of that far-famed woman "old Mother Hubbard" when she visited it with benevolent intentions for her dog—hardy and adventurous seamen and persistent landsmen have attacked circum-polar seas from every quarter, intent upon winning renown for themselves and profit for their nation.

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*Mr. Chas. C. Smith, in a paper contained in Justin Winson's Narrative and Critical History of America, states that since Frobisher's time more than 100 sea voyages and land journeys have been undertaken in quest of the North West Passage. To this number must be added those in search of a North East Passage.

†Formed from the words "United States of North America" to avoid the use of that verberian misfit "American" so often used to designate the people of one country of the seventeen or eighteen countries of this Western Hemisphere.

A thousand place-names bestowed on headland and cape and promotory, on gulf and strait and channel and bay, on river and lake, on islands great and islands small—some of them hoary with age before Poutrincourt sailed into and named Port Royal, or Champlain dug the first cellar in Quebec, some of them but of yesterday,—testify to the unresting diligence with which the men of the past and of the present have sought fame and fortune in the Frozen Sea which tumbles round the occult precincts of the elusive North Pole.

Taken as a whole these place-names have been baptised in the death-throes of full 2,000 men who have lost their lives from starvation, from cold, from disease, from wild beasts, from drowning and from murder most foul. On an average one human life has been sacrificed for each place-name given, possibly two for each.

From the seventeen score of persons drowned on the voyage from Iceland to Greenland in 983-4 to the criminal taking off of Henry Hudson, his son and his seven faithful friends, by the mutinous crew of the "Discoverie" in the wild waters of the west coast of our District of Ungava ; from the fifty who perished on Marble Island, dying one by one till the last man fell dead as he tried to dig a grave for his comrade, to the ghastly find of 30 skeletons of men in an inlet appropriately named Starvation Cove by the horrified discoverers, and that other find by Eskimos in Terror Bay of a tent, the floor of which was completely covered with the bones of white men ; from the destruction of the remainder of Franklin's men as with hunger-shrunk bodies they toiled homeward from Montreal island in the estuary of the Great Fish River, just under the Arctic Circle, down to the present time, precious human lives have been dropping, one by one, score by score, into the abyssal depths of northern seas.

Thousands of women have, like the psalmist, "eaten ashes for bread and mingled their drink with weeping" because of the loss of husband and son and lover in voyages and expeditions of which these place-names are the memorial tablets, nor were their burdens lightened by any Rudyard Kipling of the times with his song of "The Absent Minded Beggar" of more value than many "cloths of gold," as a "pot boiler."*

*The newspapers announce that the "Absent Minded Beggar" produced for the war fund the sum of $485,000.

Well and truly has Peter Sutherland, writing in 1850, said, "There is hardly an island on which one lands from the Arctic Circle to the top of Baffin Bay but it will be found in a manner consecrated by the remains of some British seamen over which the burial service has been read and a green mound has been raised and marked by a monument of which St. George's Cross is the most common form. Our friends buried within the Arctic Circle lie forgotten by all except perhaps their relatives, and unvisited save by the eider-duck which makes her nest among and on their graves." Since the worthy surgeon wrote this statement, yea, even while he was writing it, the circle of graves in the Arctic islands was much more widely extended. Through Barrow Straits and Melville Sound and McClure Straits, on the islands on both sides, there are graves of British seamen. Of the "Investigator's" crew five men died and Beechy Island and Cape Cockburn and Bay of Mercy, (Banks Land), hold their remains, while King William Land and other points hold 9 officers and 15 seamen of Franklin's fated expedition, of the other 118 men of Franklin's party who perished it may be said that their graves are scattered far and wide within the Arctic Circle.

II.

The Greeks were early in the field as northern navigators for 320 or 323 years before Christ was born into this world, Pytheas, a Greek sailor, contemporary with Alexander the Great, having learned the art of navigation in that early training school of seamen, the Mediterranean Sea, left Cadiz, (the oldest great city of Europe, name coming from *Gades*, meaning the "walled place"), then the chief Phoenician emporium, and cautiously felt his way along the coasts of Spain and Gaul and explored the shores of Great Britain. Among other things geographical he mentions as about six days' voyage from Great Britain, an island he calls Thule,* a place-name embedded in the history of place-names, as a fly in amber, by Virgil in the form of "Ultima Thule"; "the farthest off land" of the navigator of more than two thousand two hundred years ago thus coming down to us, "the heirs of the ages," as a frequently used expression to denote some far away goal difficult to reach.

*From the Gothic word *Tiule* meaning "the most distant land." We have several near relations of this word in common use, as, for instance, Telescope, Telegram, Telephone.

The poet Thomson in "Autumn" refers to Pytheas's isle when he says :

"Where the northern ocean in vast whirls
Boils round the naked melancholy isles
of furthest Thule."

The Irish, the Norwegians, the Swedes and the Danes were in the exploring business at an early date. Decuil in his book "de Mensura Orbis Terrarum," writing in 825 says "it is now 30 years since I was told by some Irish ecclesiastics who had dwelt in that island (viz. Iceland) from the 1st Feby. to the 1st of August that the sun scarcely set there in summer and that it always leaves light enough to do one's business."

Naddodd, a Scandinavian pirate in 860 appropriately named the island Sneeland (Snowland). The island was subsequently visited by two Swedes Svofason and Flokko by whom the name was changed to Iceland which it has ever since retained. In 847 the Norwegians Ingolf and Lief were such lovers of freedom that they led a body of retainers there ;

Where cheered by song and story dwelt they free
And held unscathed their laws and liberty.

Between 878 and 901 our own King Alfred justly singled out in England's emblazoned historic page as the "Great" (the only one of our 48 sovereigns so designated) was trying to make his little Wessex a model land so that he "might"—to recall his dying words—"leave to the men that came after a remembrance of him in good works." We all know what he accomplished and all realize in the words of Greene that "the memory of the life and doings of the noblest of English rulers has come down to us living and distinct through the mist of legends and exaggerations that gathered round it."

We can heartily endorse Sir Walter Besant's view of him : "There appears one who restores the better spirits of the people by his example, by his preaching, by his self sacrifice. There passes in imagination before us a splendid procession of men and women who have thus restored a nation or raised its fallen ideals, but the greatest of them all, the most noble, the most godlike is that of the 9th century Alfred. There is none like Alfred in the

whole page of history, none with a record altogether so blameless, none so wise, none so human.''

Goldwin Smith in his latest historical work ''The United Kingdom, a Political History,'' marvellous as a brilliant specimen of ''picekd and packed words'' says :

''Made ubiquitous by his command of the sea which the English had now resigned, pouncing where he was least expected, sweeping the country before the national levies could be got together and at last keeping permanent hold upon large districts, the Dane had brought the English kingdom to the verge of destruction when a heroic deliverer arose in the person of Alfred, the model man of the English race. Round the head of Alfred a halo has gathered ; his history is panegyric ; yet there can be no doubt of his greatness as a saviour of his nation in war, as a reorganizer of its institutions of which pious fable has made him the founder, as a restorer of its learning and civilization.

In the development of his wide-reaching aims, he became the founder of the science of geography in England and sent out Othere, a Norwegian sea captain, on a voyage of exploration in the course of which he discovered, about 890 A. D., the White Sea, so named because of its proximity to sterile regions white with driven snow and dazzling ice.*

Thus early did England become associated with circum-polar seas.

About 876 an Icelandic wanderer, Gunnbjorn† by name, blown out of his course by a blizzard like those which worry the life out of the people of Nebraska, Dakota and Minnesota, was compelled to pass the winter ice-blocked in an inlet of an unknown land. He and his crew, released by the welcome forces of summer, returned to tell to wondering friends the tale of their residence in the ''thrilling regions of thick-ribbed ice.''

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*C. King Alfred's account of the voyages of Othere and Wulfstan in his adaption of the universal history of Orosius. The King's account is given as he heard the voyages recounted by the adventurers themselves.

†We have on our charts in a very mutilated form a place-name commemorative of Gunnbjorn in Gomberg Scheer (Gunnbjorn's Skerry) nowadays a dangerous reef away up north—in his time a true skerry before a seismic disturbance blew it into flinders. (See Kipling's "Lights of England" for "Skerry.")

Eric Raude, (Red Eric), an Icelander, had heard by the firesides of his father and neighbours the story of Gunnbjorn's adventures and when he was convicted of manslaughter before the *Thornaes Ting* or Judicial assembly, of Iceland and sentenced to banishment for a term of years he bethought him of the story and resolved to pass the time of his sentence in exploring the unknown land. He doubled the cape, called by Gunnbjorn Hardsaerk (known to modern whalers as Cape Farewell) and 110 years after Gunnbjorn's unwilling voyage gave the land the curious name of Greenland, or its equivalent in his native tongue. When Eric, the red-headed son of a viking, called the country Greenland he was not afflicted with colour-blindness, nor did he see it through green spectacles, nor was he in a sarcastic mood as sailors are wont to be when disappointed.

He so named the fiord into which he had penetrated, because the land around it was clad in living green, the season being the prime of summer time and the grass wearing its liveliest emerald suit. Purchas in "his Pilgrimage" says "Greenland is a place in nature nothing like unto the name ; for certainly there is no place in the world yet known and discovered that is less green than it."

Sir John Ross says of an island off the Greenland Coast still farther north than Eric's fiord : " The island was a far finer object than our former experience of it at an earlier, and perhaps in a worse, season, had given us reason to expect on this icy coast and reminded us in a lively manner of the far fairer land (England) which we had quitted but a month before and of the summer which we believed we had left behind. Every practicable part of the surface, even the smallest spot which was not a pure precipice or a sea rock, was covered with verdure, while a profusion of wild plants, now in full and luxuriant blossom, rendered that a summer garden, which we expected to find (what we had often done before) a chaos of rugged rocks and cold snow. We therefore no longer wondered at those who had given the name of Greenland to a country which others, as well as ourselves, had long thought to have been ridiculed by such a denomination. It was in truth a *Greenland*."

You see it is the old story of the dispute about the color of the chamelion and about the gold and silver shield.

I may remark here that it is quite a common happening for a place-name originally applied to a small section of country to be given, in process of time, a wider range so as to become the distinguishing geographical term for a much larger area, and this happened in the case of Greenland, the whole peninsula receiving its name from Eric's fiord. Our own place-name "Canada" is "an example to the purpose quite." It was originally, according to Jacques Cartier, the name an Indian tribe gave to their movable, easily transplanted collection of wigwams. It became in time the name of two great Provinces. It is the designation of a country extending west and east from Cabot and Belleisle Straits to Mount St. Elias and Queen Charlotte Islands, and north and south from Pelee Island to Grinnell Land, with an area nearly one third of the whole area of the British Empire, not including the Transvaal and the Trans-Orange Provinces. No doubt the humor of it has kept the original Norse name of Greenland from displacement.

Eric was so pleased with his Greenland that he returned to Iceland and gathering together a number of his fellow-islanders, set out for his emerald fiord with a fleet of 25 vessels, like the one Froude has described from a specimen "which he saw and saw again" at Christiania, exhumed from its peaty grave where it had rested nigh unto a thousand years. But ruthless ice-bergs and angry winds destroyed and greedy waves swallowed up eleven of Eric's vessels with their human cargoes of 300 or 400 souls—the first recorded body of emigrants to come to North American shores —the first great loss of life on our coasts which have since witnessed so many terrible wrecks.

The other vessels succeeded in reaching the desired haven with 400 or 450 persons who began housekeeping on the west coast just north of the island we know as Cape Farewell. In course of time these first settlers and others who joined them branched out to the next fiord and then to the next and then began another settlement 400 miles further north in just about the same latitude as our youngest city, Dawson City, in far famed Klondike.

After an existence of more than 400 years the Greenland settlements were given their *coup de grace* by the Eskimos, and all that now remains as evidences of the 300 farmsteads, the two

villages and the 14 churches and one cathedral are the ruins of a few stone houses and of the Kakortok Cathedral church "where the credo was intoned and censers swung while not less than ten generations lived and died.*

Bjarni Hergulfson, another Icelander, on his way from Iceland to Eric's settlement to see his father, driven by storms out of his course, sighted land far to the south and slowly made his way back north to Greenland, seeing land occasionally as he went.

Interested in the account of Bjarni's adventures, Lief, the son of Eric, sailed in the summer of 1000 to the south till he came to a land of slate. This he called Helluland or Slate land. Pursuing his voyage southward he came to another country which he called Mark land or Wood land. Then turning west he reached a third region which he named Vinland, because wild grapes grew there. He had skirted the shores of Labrador, Newfoundland and Nova Scotia.

The Icelanders, the Norwegians and the Swedes—the men of the north—having shown the way, the men of the south put in their claim to good seamanship, possibly led by that instinct which has ever influenced the dwellers in one zone to search the countries of other zones for purpose of trade; as witness the colossal processes of Empire-building now right merrily going on, the greatest the world has ever seen; the Russians, the Germans, the French and the English nations (the Unistoniams not by any means to be omitted) all stretching out their hands for tropical countries and watching each other with keen eyes lest in the partition of Africa and the breaking up of China any one should get bigger pieces than the others. Canada, having consolidated herself from ocean to ocean by the successful achievement of the great work of Confederation, bristling as it was with many difficulties, is not without signs that she too may feel herself drawn by the magnetic force of dissimilarity, with its consequent natural expansion of trade, to enfold within her embrace the British Tropical West Indies.

Whatever the impelling cause the men of the south in that day and time in the history of the European people essayed to explore the north, the process being the opposite of that of the present era when the movement is from north to south.

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*Fiske's "Discovery of America."

The Venetians, Nicolo and Antonio Zeno (1384-94)—the first of that glorious sextet (Columbus, Vespuccius and the Cabots and the Zenos) of Italian navigators to put the world under deep obligations to them for discoveries extending the knowledge of the earth's surface—did a little exploring the account of which, for a long time believed to be fabulous, is in recent years considered to be genuine.

Antonio and Nicolo at different times visited Greenland. Whether either of them visited the mainland of the continent or any of our islands is in doubt.

The two Cabots, John and Sebastian his son, hold the first place in point of time* and in many respects the first in importance from a Canadian standpoint. John Cabot in 1497 discovered the South Eastern coast of the present Dominion of Canada, landing on the coast of Cape Breton, so it seems to be settled by a writer in the "Encyclopaedia Britannica†" and an increasing number of the ablest writers. Wherever he made his landfall, he did so, it is contended by John Fiske‡, on the same day of the same year that Americo Vespuccius first saw the South American continent with which his name was first associated through a curious error of a German cosmographer, to be subsequently extended to the northern part of this western hemisphere, which ought, in agreement with the eternal fitness of things, to memorize John Cabot, who first took possession in the name of King Henry VII of England.

Sebastian Cabot who accompanied his father on this occasion, made another voyage in 1498. He appears to have studied carefully the whole subject. His father's inquiries among the Icelandic sailors who frequented the Port of Bristol had led him, in all probability, to conclude that the shortest way to land beyond the Atlantic was by the old Norse track. Sebastian profiting by his father's observations and being himself a man of genius concluded to sail northward. He left Bristol in May, 1498 and headed for Iceland. On arriving there he steered for Cape Farewell

*The application of John Cabot for letters patent in favour of himself and his three sons, Louis, Sebastian and Sanctus is the earliest document of the archives of the Colonial Empire of Great Britain.—Goldwin Smith, "The United Kingdom, a political history."

†C. f. J. Winsor's Narr. and Critical Hist. Am. Vol. III pages 23, 24.

‡C. f. J. Fiske's Discovery of America Vol. II page 87.

from which cape he attempted to force a passage to the north, in the course of which he seems to have discovered the great strait now called Hudson Strait. Having failed to find the passage he sought, though he went a full degree north of the Arctic Circle and within 22½ degrees of the North Pole, he sailed southward for full 900 miles along our magnificent eastern sea-front, Gomara relates that Cabot had with him five vessels and 300 men. the latter intended to form a colony. Thevet, a French cosmographer, says Cabot landed these emigrants where the cold was so intense that nearly the whole company perished, although it was the month of July. If it be true that he put them ashore and that they perished, then these men must be added to Eric's 350 already mentioned as lost in the attempt to discover and people the northern regions of the Canadian Dominion.

Sebastian returned to Bristol, having made the very first voyage ever made with the specific object of finding a North West passage. He thus stands out prominently not only as the companion of his father in the voyage which led to the discovery of south eastern Canada, but also as the first man who divined that this continent was no outlyer of the Asian continent, as Columbus supposed, but was a huge barrier between Western Europe and Eastern Asia. He was also fore-runner of a long and illustrious line of seamen who, during more than two centuries sought for a short cut to Asia by a polar passage from east to west.

In the later years of his life after Edward VI in 1549 granted him a pension and created him King's Grand Pilot he conceived another idea, viz. of seeking the way to Eastern Asia by a North East Passage. The commercial association to which Cabot's genius and influence gave rise called themselves "The Company of Merchant Adventurers*." They received a charter of incorporation in 1554-5. In 1556 they obtained an Act of Parliament incorporating them as the "Fellowship of English Merchants for Discovery of New Trades," a title under which they continue incorporated though they are better known as the

*One of those trading associations which sprung from the necessities of the times when the sea was still an element outside of law and where to trade in safety it was needful to organize associations each strong enough to form a sea power, for piracy was common and half licensed and mariners of different nations warred with each other though their governments were at peace.—G. Smith.

Muscovy or Russian Company. Cabot became Life Governor, and because of his position and experience had much to do in shaping the policy and preparing the plans of the company. He instructed the captains in the company's service to observe closely the variations of the magnetic needle and for that purpose introduced the Log Book, declared to be the most admirable of all the inventions for the furtherance of the science of navigation, ranking, probably, in the minds of practical seafaring men next to the three "L's" of the sailor, the Lead, the Log and the Lookout.

The first expedition the Company despatched was that of Willoughby and Chancellor in 1553, before they obtained their charter. The departure of the pioneers with their three Bonas—*Edward Bonaventure, Bona Esperanza and Bona Confidentia*, as their ships were named, is described by a reporter of the day; "At Greenwich the common people flocked together; the courtiers ran out; the Privy Council looked out of the windows, and the others ran up to the tops of the towers. The ships shot off their ordinance insomuch that the hills sounded therewith. The valleys and the waters gave an echo and the mariners shouted so that the sky rang again with the noise thereof. From every point of vantage on shipboard the men wave their farewells. One stands on the poop of the ship and by his gestures bids farewell to his friends. Another walks upon the hatches. Another climbs the shrouds. Another stands upon the main yard and another in the maintop"—and thus with cheering and waving of hats and hands the vessels pass on and out of the historic river on their perilous voyage.

Thus has it ever been when Britain sends out her "Tommy Atkins" and her "Jack Tars" to encounters in which there are sure to be dangers and likely to be deaths.

Sir Hugh Willoughby discovered Nova Zembla—or as it is called now Novaya Zemlya, "the Newland," attempted to winter in Lapland and perished with the crews of his two ships. In all 70 men were frozen to death. The poet says of the cold that it

> ——To the cordage glued
> The sailor, and the pilot to the helm,"

and thus, two years after, some Laplanders found Willoughby's ships uninjured, as sound as when they sailed away from the Thames followed by the hearty good wishes of high and low.

But the 70 dead bodies all silent gave no welcoming cheer to the Laps. They had died at their posts like Englishmen.

Chancellor explored the White Sea to the mouth of the "Dwina," left his vessels and travelled overland to Moscow, tried the journey a second time and was drowned when returning to England in 1556.

Interest attaches to the expedition of Willoughby and Chancellor because of Sebastian Cabot's connection with it. Cabot drew up the instructions for the conduct of the expedition being too old and infirm to take personal command. He did not confine himself to the scientific part. One clause in his instructions directs that "no blaspheming of God, or detestable swearing be used in any ship, nor communication of ribaldry, filthy tales or ungodly talk be suffered in the company of any ship; neither dicing, tabling, carding or other devilish games to be frequented whereby ensueth not only poverty to the players, but also strife, variance, brawling, fighting and oftentimes murder, to the destruction of the parties and provoking of God's wrath and sword of vengeance."

In the same year that witnessed the drowning of Chancellor we catch a glimpse of the first navigator to look upon the shores of the Arctic fringe of Canada from an English ship. In that year Stephen Burroughs, who had sailed with Chancellor, was sent to the north in a small pinnace called *Searchthrift*. Previous to sailing from Gravesend, the right worshipful Sebastian Cabot and a large party of ladies and gentlemen paid a visit to the vessel and afterwards, says the chronicler, "the good old gentleman, Master Cabot, gave a banquet, at which for very joy that he had seen the towardness of their discovery, he entered into the dance himself among the rest of the young and lusty company." The "good old gentleman" was then over eighty years old.

I have dealt thus lengthily with Sebastian Cabot, 1st, in order to bring all the relevant events of his life together for the purpose of showing that in the discoverer of the eastern side of the country now called the Dominion of Canada, we have a hero of whom we may be proud and justly so, and, 2nd, To show that his discovery first at its south-east corner and then at its north-

east corner is the foundation of the claim that England made in after years to the proprietorship of this country including Hudson Bay and the islands forming "our northern fringe."

The Cabots' voyages were the first of those westerly sailings which are the title deeds of Canada as the Empire's Trustee.

When the union of the provinces after many years of discussion, more or less polemic and academical, came within the sphere of practical politics by the assembling in 1865 in the city of Quebec of the body of public men known to us of the present generation as "The Fathers of Confederation"—a sadly minished body to-day—there was much talk and much writing in the newspapers about the name by which the young auxiliary nation should be known. Among many suggested, Cabotia seemed, especially in the east, to be the favourite. Other considerations rather than historic justice dominated the minds of the "Fathers," and the place-name "Canada" was selected and given the wider application to suit the new conditions.

We have not altogether slighted the memory of the first navigator who sailed along the eastern sea-front of this country. In the more recent maps of the Dominion the name Cabot Strait, to designate the passage connecting the gulf of St. Lawrence and the Atlantic Ocean between Cape Breton and Newfoundland, fittingly commemorates the earliest discoveror of this country. It is, I believe, the only Cabot place-name in Canada.

Perhaps when the United States take their place within the Empire the part of the continent staked off for the Britishers—Canada included—may receive the general name of Cabotia. Who knows?

To go back to our story. In 1500-01 a Portuguese explorer, Gaspar Cortereal, moved thereto by knowledge of the Cabots' voyages of 1497 and 1498 and by desire to see if some of the land visited by Cabot lay east of Borgia's Meridian* and could there-

*Borgia's Bull was a decree issued by Rodriga Borgia, Pope Alexander VI., by virtue of which Spain had conferred on her Sovereigns the possession of all lands discovered or to be discovered lying west of a meridian 100 leagues to the west of the Azores and Cape Verd Islands. A year after (1494) the line was removed to a distance 370 leagues west of the Cape Verd Islands. This would correspond to a line between the 41st and the 44th meridians west of Greenwich. East of this line lands discovered, or to be discovered, belonged to Portugal and west of it to Spain.

fore be claimed by Portugal, set out on a voyage to the Labrador coast, touched at Greenland, and possible entered Hudson Straits and the gulf of St. Lawrence, perishing on his second voyage with all his crew. His brother Miguel in 1502 with three ships going in search of him met the same fate, the two brothers and their shipmates being the earliest recorded victims of pelagic voracity in the northern waters with the exception of Red Eric's emigrants and of Bjarni Grimolfsson with part of his crew whose fate (1010) is so pathetically told in the Saga Thorfinns Karlsefnis.

Down to 1560, 42 voyages of discovery had been made. These may be deemed early efforts to penetrate the arcana of the north. Of the 42, eight were by French, eight by English, six by Swedish and Norwegians, six by Icelandic, two by Venetian, seven by Spanish and four by Portuguese navigators. But with the exception of those of the Cabots and the Cortereals they do not concern us for the present purpose.

We come to the Elizabethan age (1559-1603), that age so marked by splendid achievement that even the marvels of the Victorian age have failed to thrust it into the back-ground. Eleven voyages of discovery by English navigators mark that era as the special period of English hyperborean adventure, the records giving but ten voyages by all other nations during Elizabeth's reign—one Danish, one French, three Dutch and five Spanish.

The high latitudes of Canada were the scene of the achievements of Frobisher and Davis.

Martin Frobisher deemed the discovery of the north west passage the only thing in the world that was left undone by which a "notable mind might be made famous and fortunate." There have been many notable minds made famous and fortunate since Frobisher's day without reference to the North West Passage, so that in all liklihood Frobisher was what we should call a "crank" on the subject. He had studied the question of circumpolar navigation very closely. To him, to Gilbert and to Willes was due the resumption of the awakened interest in the discovery of a North West Passage, which had slumbered from the time the Muscovy Company, under the powerful influence of Cabot, directed its attention to the North East Passage; for

Cabot, after his experience of western ice-bergs and ice-packs, had abandoned the idea of a practicable North West passage, had devoted himself to other projects and had been dead two or three years when Frobisher began to agitate in favour of a renewal of the attempt to attack the problem from the Greenland side. After long and persistent efforts he succeeded in interesting persons of means and influence in his project and in 1576, nineteen years after Cabot's death, he, mainly by the help of the Earl of Warwick, obtained two vessels—the *Michael* and the *Gabriel*, one of twenty-five tons and the other of twenty tons burden and a small pinnace, with crews all told numbering thirty-five men. With these he sailed from the Thames, cheered with a message from the Queen herself.

By Willes, Gilbert, Stephen Burroughs (the celebrated North Eastern Arctic explorer of the day), Dr. John Dee (the official adviser of the Muscovy Company), Richard Hakluyt, Michael Lok and others well versed in such matters, he had been assisted with all the geographical knowledge of the day. Among the subscribers were Queen Elizabeth, who took £4,000 of stock, Lord Burleigh, the Earl and Countess of Warwick, the Earl of Leicester, the Earl and Countess of Pembroke, Sir Philip Sidney, Sir Thomas Gresham, Sir Francis Walsingham and Michael Lok (who subscribed £5,000)—the total subscription being £20,000.

Frobisher's agitation of the question had created so widespread an interest that to him may be attributed justly the truly national character which from his time onward Arctic research assumed.

The list of subscribers, as is evident from the partial mention of the names, included many of the famous names of the age. Every history of the times is studded with the names of the men who hurried to sign the subscription books for Frobisher's Arctic exploration.

From the Thames, Frobisher directed his course to the Shetland Islands. In the storm and tempest that swept the ocean the pinnace was lost. Soon after that calamity overtook him, the *Michael* deserted. The *Gabriel* kept on her northwestern course, was nearly wrecked on Greenland's rugged coast, and finally after a two months' voyage arrived at land to the north of the out-rushing waters of the strait now known as Hudson. The first land he sighted he named Gabriel Island,

after the staunch little vessel that had carried him thus far in safety.

This is the first place-name given in the high latitudes of North Canada that has remained.

Cabot called the strait Rio Nevado*—the river of snow—and Cortereal named it the Anian Strait† believing it, from its outrushing water, to be the eastern or lower end of the passage through which a vessel might go to Cathay. But the Cabot name never fastened itself, and the Cortereal name so confused the geographers that by 1556 it was applied to the north and south passage between Asia and this continent to continue so applied till it, too, found a place in the ash-heap of lapsed and and discarded names, Behring's name being properly substituted, though not before many a navigator had vainly hunted high and low for the Anian Strait on both sides of this continent.

On this voyage Frobisher named Prior's Sound, Thomas William's Island and the Five Men's Sound, in which latter body of water was one Island he named Trumpet Isle, and a second he called Butcher's Island.

He landed on the last named on the 19th August, and on going to the top of it to see if there were any people or no, he says "he had sight of seven boates which came rowing from the east side." With the occupants of these he made acquaintance and gave them "thridden points" (sewing needles).

This was the first acquaintance of Englishmen with our fellow subjects the Eskimos, and of the Eskimos with the predecessor of the modern needle which plays or plies so important a part in domestic economy that like the telephone we don't know how the world got along without it. Frobisher describes the natives: "They be like the Tartars, with long black haire, broad faces, and flat noses, and tawnie in colour, wearing sealskins as

*Cortereal is supposed by some to have named the straits (Hudson) Rio Nevado, and Dr. Richardson says the name *Nevado* has been transferred to some mountainous islands on the north side that even in summer are covered with snow. I have followed Asher ("Henry Hudson, the Navigator," page 257.)

†There has been much discussion about the derivation of this word. The most generally accepted idea is that mentioned above. It has often occurred to me that Cortereal possibly named the strait Anian, not because of its supposed end of a passage through the continent, but because of the great number of eider and other duck he found there; that bird being ornithologically a member of the anas family—anas molussima.

also doe the women, not differing in fashion from the men, but the women are marked in the faces with bleue streakes down the cheeks and round about the eies,''—from all which it is apparent that sealskin coats, made to look like men's, and painted cheeks are no modern fashion among the women of this continent. The first wearers and users, our comely sisters of the northern fringe of Canada, set the fashion no one knows how many centuries ago.

''On the 20th day,'' continues Frobisher, ''we wayed and went to the east side of the island,'' where they saw the Eskimo's houses. One of the natives returned to the *Gabriel* with them and to him they gave a ''belt and a jack-knife and then ordered five men to put him ashore at a rocke and not among the company (of the Eskimos) but their wilfuleness was such that they would goe to them and so were taken themselves and we lost our boate.''

''The next day in the morning we stoode in near the shore and shotte off a fauconet and sounded our trumpet but we could heare nothing of our men. This sound we therefore called the Five Men's Sound.''

The fate of the five men is unknown ; whether they settled down and took to themselves Eskimo wives and left a white strain in the blood of the natives or whether they were eaten without salt or roasting no one knows ; no trace of them was ever found.

Trumpet Island was probably so called because of the echo of the sounding trumpet the island's precipitous sides returned as the messmates of the five abducted seamen sought to inform the unfortunate quintet of their whereabouts.

This first acquaintance with our brothers and sisters of the seal-skin garment has not been improved or deepened since. We know in a general sort of a way that there are about 4,000 of them included in our population and even that is an estimate now 30 years old. Missionaries have gone from Canada to the heathen of Asia and Africa but to these little people of the land of the white bear we have paid scant or no attention. Dr. Richardson and McClure and Armstrong found them very unwilling to cultivate closer relations with the Kabloonas, or white men, ''because the white men gave them water that killed them,'' to which fateful gift they have decided objection. Possibly by preserving a ''splendid isolation'' they have increased and multiplied. But they have been left to their paganism by the mission societies, almost their only point of contact with white men being at Herschell Island near Mackenzie River where whaling ships often

winter, and possibly on the Labrador coast where the Moravians have established missions. The Indian Department here has not brought them within its fold. In fact the Innuits of Canada's northern fringe may truly say "no man careth for our souls" and yet they are the most interesting of all the races on this continent for many reasons that cannot be given in detail.*

Having to abandon the men, Frobisher returned to England taking with him some gold which may be considered the first discovery of the yellow metal on the Arctic slope of the country known as the Dominion of Canada, the harbinger of the coming time when in a single season more men rushed towards Canada's part of the Arctic Circle for the gold of the Klondike than during four centuries manned all the barques of all nations seeking fame and the North West and North East passages to Cathay and the land of the tea plant.

In consequence of the rumors which soon circulated of the value of the "find" great enthusiasm prevailed in England, and Frobisher had no difficulty in obtaining the means for another expedition. The Queen contributed £1,000 and loaned a ship of 200 tons from the Royal Navy. With this ship and his former vessels and a complement of 120 men, Frobisher sailed and arrived at Hall's Island on the third week of July, 1577. He named the Island after the captain of the Royal ship; the Queen's Foreland in honour of Queen Elizabeth, and Best Island after his second lieutenant, who was also the chronicler of Frobisher's second voyage. His own name was given to Frobisher Strait, the belief being that it was a strait, and not, as we now know it to be, a bay. Jackman Sound was named after the master gunner of the "Aide," the Royal ship.

At one stopping place the Eskimos made a fierce assault upon his men "with their bowes and arrowes." In self-defence he wounded three of the natives. These fearing to be captured, in their desperation leaped off the rocks into the sea. "We named the place Bloody Point, and the bay or harbour Yorke Sound, the latter after the Captain of the Michael."

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*I have recently learned that the Anglican Church has two or more Missions among the Innuits of our Northern Fringe.

The chief object of this expedition was to collect "black earth" to be taken home and tested for gold. They anchored in a fair harbor, which they named Anne Warwick's Sound, giving the name also to an island in honour of the Countess of Warwick, who, with her husband the Earl, had enthusiastically promoted the first expedition."*

After filling up with black earth and making earnest but fruitless efforts to discover the fate of the five men, Frobisher returned to England where he was greeted with great enthusiasm, the Queen naming the great island from which the "ore"† was chiefly obtained, *Meta Incognita*, and throwing a chain of gold around Frobisher's neck.

A larger expedition was planned, and in 1578 Frobisher sailed on his third voyage with two of the Queen's ships, one of 400 tons and the other of 200 tons burden. Besides these, thirteen vessels of various sizes accompanied him. With him were 120 pioneers and 400 other men, of whom 100 were designed for the special task of forming a colony. These were landed in Frobisher Bay, and at the time were considered to be "the first known Christians that we have true notice of that ever set foot on the soil" of that part of the Dominion of Canada.

Things however, did not turn out according to expectation. One of the ships was lost. Ten persons died. The others appear to have resolved not to remain. Stormy winds and dangerous ice frightened them. On one occasion the chronicler says, "Thus continued we all that dismal and lamentable night in this perplexitie looking for instant death."

October found the joyful survivors with their feet on English soil ; and so ended one of the early efforts of the sturdy English in the line of colonizing, a line in which from natural aptitude, and after long and sometimes bitter experience, they have no equal among the nations ; Spain, France and Italy all failing, and Germany as yet giving no great evidence of special

*Captain Hall in 1860-62 discovered the remains of the stone house which Frobisher built on Countess of Warwick's Island in 1577, as well as other relics of the great navigator. These latter he sent to England; a more appropriate resting place for them would be Ottawa, the Federal capital.

†The worthlessness of Frobisher's ore resulted in luckless Michael Lok being unable to redeem his suretyship. He was cast into Fleet prison, a catastrophe which involved himself and his fifteen children in ruin.

readiness and skill as a colonizer of the waste places of the earth

It has been said that the Russians are the best linguists of Europe because every other language is so easy in comparison with their own. Possibly the British have found it easier to colonize the whole earth because their earlier efforts were directed to the bleak parts ; after conquering these it was child's play to conquer the rest.

Frobisher took back to England the information that between 62° and 63° on the eastern side of North America a wide entrance existed, navigable for hundreds of miles, and that a still broader and more navigable entrance had been found between 60° and 62°. "This information was more than sufficient to raise the most lively hopes of a through passage and the most ardent aspirations towards its discovery, especially in an age that may well be said to have given birth to the buoyancy and elasticity of spirit by which the English nation has since become so great."*

Though Frobisher exerted himself to his utmost to secure the means for a larger expedition ; though he was supported in his efforts by England's great seaman, Francis Drake, who offered £1,000, when he could ill afford it ; and though the Earl of Leicester subscribed £3,000, the enterprise came to naught ; and thus passes out of our specially Canadian story, the man Frobisher, who is justly regarded as one of England's great naval heroes.

He had the Yorkshireman's faculty for getting on in the world. After he abandoned Arctic exploration he commanded a ship in Sir Francis Drake's expedition to the West Indies and in 1588 he did such excellent work in the "Triumph" against the Spanish Armada, that he was rewarded with the honour of knighthood. In 1594 he took part in the seige of Crozan, near Brest, received a wound, was taken to Plymouth, and there died.

Frobisher's voyages are also "western sailings" in the account of which we read our "title deeds" to the "Northern Fringe" of our country.

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*G. M. Asher.

The next of the hardy English navigators whose explorations are "title deeds" was John Davis.

John Davis was born in Devon, that fruitful mother of great seamen, whose impress upon the history of England is out of all proportion to the population of the county.* By them Newfoundland was discovered. These adventurous old Devonshire sailors year by year left their little ports to reap the harvest of the seas along the shores of the great island, which in their homely way they called the "new found land." By them the ancient colony was largely peopled in the first instance. Prowse in his history of Newfoundland says, "Many peculiarities of the colony can be traced to our Devonshire forefathers." One of these, germaine to our subject, is that all the lakes in Newfoundland are called ponds, the reason for which is that in the south west of England there are no lakes, only ponds, a curious transfer of a familiar name from one side of the ocean to another.

From Devon came the friend and playmate of John Davis, Sir Humphrey Gilbert, whose pathetic fate off our south eastern Canadian coast is told in song and story which have enlisted in his behalf the sympathies of the school boys and school girls of Canada from the time of the first English school in Halifax 150 years ago.

From Devon also came Gilbert's half brother, Sir Walter Raleigh, who planned the strategy which conquered the Spanish Armada, and whose fame is commemorated by a tablet erected in Westminster Abbey on which is inscribed, "Raleigh, the founder of the English Empire in America."

Another Devon man was Sir Francis Drake, the first of Englishmen to circumnavigate the globe, the vice-admiral of the English fleet when the Spanish Armada swept the British Channel, intent on the invasion of the British Isles.

Sir Redvers Buller, who planned the three marvellous springs of the British Lion at his prey, on Dec. 10th (Gatacre's) 11th (Methuen's) and 14th (Buller's)—which, when the sad clash of

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*Devonshire, the county of cream, has well been called the cream of counties, from the illustrious men and history-makers it has produced, and it is still as prolific of sailors and soldiers as it was in the days of Drake and Raleigh and the other west county paladins of the good Queen Bess.

arms of British and Boer on South African veldt and daal and boschveldt shall have passed into history, will, I believe, be deemed wonderful though unsuccessful displays of energy—is also one of Devon's treasured sons.

John Davis, one of the greatest navigators, was associated with Sir Walter Raleigh and Adrian Gilbert in a charter granted them by Queen Elizabeth in 1584 for "the discovery of a new North West passage to China." Their interest in the enterprise was awakened by a book on the possibility of the discovery of a new North West passage written by Sir Humphrey Gilbert. William Sanderson, who had married Raleigh's niece, supplied the greater part of the needed funds. On June 7th, 1585, their expedition left the Devonshire port of Dartmouth. It consisted of two barks, the *Sunshine* of London (50 tons) and the *Moonshine* of Dartmouth (35) tons). They were determined to have some sort of *shine* to keep them company and a very good resolve it is, not only on Arctic voyagings but in all life's daily round.

On July 20th, writes John Janes, merchant-servant to the worshipful Master William Sanderson, "as we sailed along the coast (of Greenland) the fogge brake up and we discovered the land which was the most deformed, rocky and mountainous land that we ever saw. The first sight whereof did shewe as if it had been in forme of a sugar loafe standing to our sight above the cloudes, for that it did shewe over the fogge like a white lifte (rift) in the sky, the tops altogether covered with snowe and the shore beset with yce (ice) a league off in the sea making such urksome noise as that it seemed to be the true patterne of desolation and after the same our captain named it the Land of Desolation."

In accordance with a not uncommon experience this place-name is now applied not to the whole region but to one particular spot, a headland called Cape Desolation.

On the 6th August, Janes writes "Anchored in a very fair rode under a very brave mountain the cliffs whereof were as orient as gold. This mount was named Mount Raleigh. The rode wherein our ships came to an anker was called Totness Rode. The sound which did compass the mount was named Exeter Sound. The foreland towards the north was named Cape Dyer and that towards the south was named Cape Walsingham."

The mount was, of course, named in honour of Sir Walter Raleigh who would have been with the expedition but the Queen would not let him go, being unwilling to deprive her court and herself of his handsome presence and his beautiful legs.

Totness Road was named after Totness near Dartmouth, probably because their ships had been fitted out there. Exeter Sound commemorated the chief town of their loved Devonshire. Cape Walsingham received its name in honour of Sir Francis Walsingham, one of Queen Elizabeth's famous statesmen, a diplomat often at his wit's end through Queen Elizabeth's extraordinary vacillations, yet serving her and his dearly loved England with great energy and wisdom and with a stout independent English heart. He had endeared himself to Davis because of the help he had given to Sir Henry Hakluyt and other navigators in their voyages of discovery.

Cape Dyer was named after a personal friend, Sir Edward Dyer, Chancellor of the Order of the Garter.

On the 14th August, Janes writes, "we came to the most southerly cape of this land which we named Cape of God's Mercy as being the place of our first entrance from the discovery"; meaning that having explored the strait now called Davis Strait and from a point within the Arctic Circle having gone south homeward bound they desired in this way to express their gratitude to God for their preservation. Those old-style sailors were God-praising men, in their own way.

The coast line they had explored was named Cumberland and the sound of which Cape of God's Mercy is the northern headland they named Cumberland Sound, after another friend of Davis, George Clifford, Earl of Cumberland.

From Cape of God's Mercy they returned to England and were able to report that they had sailed round the southern point of Greenland, had gone north along the west coast of Greenland to Gilbert Sound which Davis so named in remembrance of his old playmate, the hapless Sir Humphrey, who had perished in the foundering of his little 10 ton vessel, the *Squirrel*, off the coast of Nova Scotia encouraging his men by calling out "we are as near heaven by sea as by land"; had crossed the strait now called Davis Strait and had reached the western shores of the continent on the 6th August, at Cape Walsingham, and had explored the

coast for several days, leaving on the 24th August, and reaching England on the 30th, September. By an admirable course of reasoning he gave his conclusion that "Davis Strait does lead to the Pacific."

Encouraged by his report, the promoters sent him out again, this time with four vessels—the "Sunshine," and the "Moonshine" (as before,) the "Mermaid" (100) tons and the "North Star," a pinnace of 10 tons. They arrived in Gilbert Sound at the end of June and began searching for other openings besides those found in the previous expedition. Soon they encountered huge packs of ice. The crew of the new ship the "Mermaid" had not seen the Arctic regions before. They quailed in front of the huge icebergs and at length mutinied. They were partially subdued by his imposing presence and entreated him "not through over-boldness to leave their widows and little children to give him bitter curses." He sent the "Mermaid" home. He himself continued his exploration and found two more openings, Davis Inlet and Sound and Souctoke Inlet. On the 21st August, they were in Gilbert Sound where, according to the narrative, the natives whose confidence he sought to win through the sweet medium of music "did on divers times woo us on shore to play with them at the football and some of our company went on shore to play with them and our men cast them down as soon as they did come to strike the ball." Thus early was football introduced in the hyperborean regions and body-checking indulged in. Davis soon after that set sail for England, as he passed naming Cape Farewell on the extreme southern point of Greenland and arrived home in the beginning of October.

On the 19th May, 1587 Davis left England on his third voyage having with him his favourite vessel the "Sunshine" and the "Elizabeth," and a clinche named the "Ellen of London" and on the 30th June, had reached latitude 72° 12, nearly four degrees further north than any one had been before in that sea. He saw before to him to the north "no ice, but a great sea, free, large, very salt and very blue" and "it seemed most manifest that the passage was free without impediment towards the north." Northern gales and the wish to proceed towards the west prevented him sailing further in this northern direction. He tried to sail westward and succeeded in going 44 miles deflecting but

slightly to the south. The winds, however, drove the ice upon him and he had to retreat towards the Greenland coast and finally he gave up the attempt in that latitude and reached his old anchorage beneath Mount Raleigh. He then explored the Cumberland Strait hoping to find a passage but the ice was too strong a barrier. He returned to the mouth and sailed southward. He passed Frobisher Bay and Hudson Strait noting as he crossed the latter "that the sea fell down into the gulf with a mighty overfall and roaring and with divers circular motions like whirlpools, in some sort as forcible streams pass through the arches of a bridge."

On this voyage he named the most northerly point he reached in Greenland "Sanderson his hope of a North West Passage," (now in our maps cut down to "Sanderson's Hope,") after William Sanderson the London merchant whose public spirit had induced him to supply the means for the expeditions with which Davis's name is connected. He also named the Cumberland Islands, Lumley's Inlet and Cape Chidley, the latter after a Worthy of the times deeply interested in Arctic exploration. He reached England in the middle of September and his further history concerneth us not in this connection. Canon Taylor says, "Davis needs no tomb-stone, as he has written his name conspicuously upon the map of the world."

In the 17th century, after Queen Elizabeth's death, the records show 20 English voyages of discovery, 8 Danish, 6 Dutch, 5 Russian, and one Portuguese, in all 40, just one half of them English : Spanish and French dropping out altogether.

Of these 40, the ones of interest to us in connection with our District of Franklin are those of Hudson, Button, Bylot, Baffin, and Fox.

Henry Hudson claims the next place in chronological order, as one of the navigators whose "western sailings" are our "title deeds" to the northern fringe of Canada. But though he named Salisbury Island, one of the southern islands of Franklin District and therefore comes within the charmed circle of those whose fame is connected with the District which is to-night our special

study, yet his exploits are chiefly associated with Hudson Bay* and the southern lands of Hudson straits. I have prepared a full account of his deeds in our waters and elsewhere but must reserve it for some other occasion.

On account of the deep damnation of Hudson's taking off much interest was aroused in England and many attempts were made to ascertain his fate. In 1612 Sir Thomas Button sailed with two vessels. His first place-name was "Carey's Swan's Nest." His next was "Hopes Checked" and then on to Port Nelson at which place he wintered and then went North to latitude 65° the highest point he reached and somewhere near Cape Comfort. He, like Hudson, sailed within the boundaries of Franklin but does not seem to have been otherwise associated with its "title deeds."

A little less than a year after Button's return to England, the Muscovy Company—Sebastian Cabot's Company—sent out (1615) Robert Bylot and William Baffin who then and thus embarked on the first of the two voyages commonly associated with their names. They sailed from the Scilly Islands, April 1615, in the "Discovery" a vessel of about 55 tons in which Bylot had already made three voyages to the North West. Following a course already familiar to him they passed through Hudson Straits and went up what is known as Fox Channel. Here and at the western end of the Hudson Straits they spent about three weeks in exploring and then went back to England.

Their next voyage was one of greater interest and importance and ranks among the most famous of arctic voyages. They sailed from Gravesend on 26th March, 1616, with a ship's company numbering 17 persons and coasting along the western shore of Greenland and through Davis Strait they visited and explored both sides of the Great Sea that has ever since borne the name of Baffin Bay. On this occasion they discovered and named the important channel known as Lancaster Sound and also discovered and named Jones Sound, besides numerous smaller bodies of water and many islands since become familiar to Arctic voyagers†.

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*"Hudson Bay is both the tomb and the monument of the daring navigator who discovered it." Isaac Taylor; "Names and their histories."

†C. C. Smith in Justin Winson's Narrative and Critical History Vol. III, pages 93-94.

They discovered and named Savage Island, Cape Comfort (because of the hopes Bylot was then led to entertain of the existence of a North West Passage), Mill Island, (from the way the ice floes were ground up there by the rushing waters), Women's Island (because Baffin there found two or three native women), Horn Sound (because Bylot traded there with the Indians for sea otter and unicorn's horns), Wolstenholm Sound (after the second Sir John W. who aided Bylot and to whom Bylot wrote a long account of his explorations); and Hakluyt Island, the latter after Rev. Richard H. who collected and published in 1582 "Divers voyages touching the discovery of America and the principal navigations, voyages, trafficques and discoveries of the English nation made by sea and land," and is the first and greatest English compiler of sea voyages.

Lancaster Sound and Channel were named in honour of Sir James Lancaster, who aided to equip the Baffin expedition and was a Director of the East Indian Company and the first Englishman to sail round Cape of Good Hope to India (1591-4). Jones Sound was so named for Alderman Sir Francis Jones, a London merchant, who also aided to equip Baffin's expeditions.

Baffin also named the most northerly opening of Baffin Bay, Smith Sound, after a very important man in his day, Sir Thos. Smith, who was the life and soul of the East Indian Company during the first year of its existence. When James Lancaster came back to England after an absence of three years and reported the greatness of the field in India for English mercantile enterprise a few merchants sent off a ship for the purpose. The success of the venture occasioned the formation of a company and Sir Thos. Smith was its first Governor continuing to hold that office for many years. The marvellous career of the East India Company is sketched by Macaulay's graphic pen in his essay on Warren Hastings. After its doings had been the history of the English in India for nearly 260 years its political power ceased and the Queen was proclaimed Queen of India in 1858, subsequently being proclaimed, on Jan. 1st, 1877 at Delhi before the princes and high dignitaries of India, Empress of India — all these great events and this magnificent addition of India to the pages of British history springing from the action of a few merchants like Sir Thomas Smith.

To Baffin is due the fact that there are on the map of our District of Franklin, the place-names of Whale Sound, because of the number of whales they saw sporting there—those orators (spouters) of the deep being very abundant in that locality; Sir Dudley Digges Cape, and Carey Island, after promoters of the voyage.

Purchas says Baffin "died in the Indies slain in a fight, shot as he was trying his mathematical projects and conclusions," in order to find the range of the castle for his cannon. But though nothing is known of his later life "after years have verified all that this admirable old navigator ever asserted and his name will cling to the waters of the mighty bay he discovered as long as honest worth shall be recognized in the world.*

By Baffin the flag of England had been hoisted and possession taken of the lands and islands from Smith Sound south along the western shore of Baffin's Bay. Baffin is thus one of the hardy navigators whose "western sailings are our title deeds."

Fifteen years elapsed before any other attempt was made by the English to penetrate the maze of islands on the west shore of Baffin Bay.

Luke Fox in 1631 made a considerable exploration of Hudson Bay and named various islands, promontories and bays. Among the islands are Brooke-Cobham in honor of his patron, Sir John Brooke-Cobham, Briggs† his mathematics, etc. Among headlands are Cape Marie, Cape Dorchester, King Charles his promontory, etc. Sir Thomas Roe's Welcome is also his place-name.

Sir Thomas Roe was an eminent political agent who flourished 1568-1644. One of his missions was to the court of the great Mogul, 1615-18. His Journal is one of the leading authorities for the reign of Jahangir (the Great Mogul). Goldwin Smith says of him "the sage Sir Thomas Roe conjured the East India Company to content itself with factories and trade." Sir Josiah Child, on the other hand, in the reign of William III desired that

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*Markham's voyages of William Baffin.

†Henry Briggs was a mathematician who promoted Fox's Expedition and wrote a treatise on the North West Passage. Evidently Fox did not want him to be confounded with any other of the Briggs family.

his company, should be a military power, and such it became, destiny compelling it to conquer and to annex.

Taylor says the name was originally given to an island and afterwards transferred to the channel in which the island lies, by either Button or Fox. It was given because the giver believed that it would be welcome news to Sir Thomas to learn that a channel had been found leading to the East. It is thus that through its place names our Northern Archipelago is associated with British India.

In 1670, as we know, the Hudson Bay Company was incorporated and soon established itself on the shores of Hudson Bay, there to begin that marvellous career which has been so well described by Beckles Willson.* They did not however, during the 17th century attempt explorations in the northerly regions. They had too much to do alternately protecting and fighting that curious product of the times, the freebooter Radisson ; defending themselves from that marvellous man, the French Canadian son of Charles Lemoyne, the Sieur d'Iberville ; and establishing themselves in the good graces of the Indians of the Hinterland.

During the 17th century the English despatched 16 exploring expeditions to the frozen ocean, the Russians 18, the Dutch 1, the Unistoniams then first entering the lists. The Hudson Bay Company despatched six expeditions at different times in fulfilment of an undertaking in their charter. One of them was commanded by Henry Kelsey, who is undoubtedly one of the heroes for whom we are indebted to the Hudson Bay Company. Forty years before Verendrye's journeys of discovery, Kelsey, then a young man, had penetrated (1691) the interior of Rupert's Land, had crossed the Assiniboine Country, had seen, for the first time among English and French explorers, the buffaloes of the plain, had been attacked by the grisly bears of the far west, and, in behalf of the Hudson Bay Company, had taken possession of the lands he traversed and secured for his masters the trade of the Indians hitherto considered hostile.* But though he was prosperous by land, in the two voyages he made by sea he does not appear to have made any discoveries of importance to our narrative.

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*Beckles Willson's "The Great Company," page 180.

The first water expedition of the Hudson Bay Company in search of a North West Passage was unfortunate. Opposite the names of the "Albany" frigate and the "Discoverie," the Hudson Bay Company had to write the ominous words, "never returned." For nearly half a century the fate of the men of that expedition remained unknown. Then (1767) some whalers connected with the Black Whale Fishery, the company was at that time carrying on, made Marble Island their rendezvous, and visiting its shores found English guns, anchors, and other articles lying about. When the tide ebbed the hulls of two craft were seen lying in two fathoms of water. Inquiries were made and in the course of a few years the details of the sad fate were pieced together. The two vessels were damaged and made the harbor; the crews, landing, set about building the house whose ruins had attracted the whalers. After finishing the house they seem to have set to work repairing the ships. The first winter passed and the succeeding summer faded into winter. By this time thirty of the fifty persons composing the company were dead. When spring advanced the Eskimos crossed over to the mainland. When they returned they found only five alive. These they supplied with food, seal's flesh and whale's blubber, which they in their distress devoured raw, and, in consequence, three of the five died. The two survivors, though weak, managed to bury their dead and for some weeks kept themselves alive. Hoping against hope, they frequently dragged themselves to the summit of a nearby rock to look for a relief party. At last they were seen by the wandering natives to crouch close to one another and to weep like children. Then one died and the last man of the fifty tried to dig a grave, but fell over the dead body of his fellow, himself a corpse. "The Eskimo, who told the story as he had heard it, took the whalers to the spot and showed them the skulls and larger bones of the luckless pair, then lying above ground, not a great distance from the dwelling."*

The uncertainty of the fate of the men of the "Albany" and the "Discoverie" was not the reason why so little energy on the part of the English appears in the 18th century. During the

*"Journey from Prince of Wales Fort in Hudson Bay to the Northern Ocean," by Samuel Hearne.

first half of it Englishmen were busy fighting battles on the continent, which called for every man England could spare. Blenheim and Ramillies and Malplaquet ear-mark the period for us. Sixty battles in fifty years leave little room for other work. In the early years of the century the exigencies of England were so great that the fleet was raised to 30,000 men and the army to 10,000, then deemed extraordinary figures indicative of great strain upon the nation's resources. John Churchill, Earl of Marlborough, who, as Voltaire notes, never besieged a fortress that he did not take or fought a battle which he did not win, was fighting his way to the Danube to win the battle of Blenheim. It was the day of the first of the great Commoners, Walpole and the Pitts. The century saw the Seven Years' War, which, opening *on land* with a brush between a small body of troops under Washington and a party of French under Jumonville at Fort du Quesne, and *on sea* with the naval engagement between Admiral Boscawen and the French ships "Lys" and "Alcide" in the fogs of the Newfoundland coast, soon kindled the world into a flame.

These acts were the "beginning of the end" of that contest for commercial control of the world which that first of Imperial Unionists, Sir William Petty, (ancestor of our Lord Lansdowne) recognized as already world-wide in his time, (1676) and for the prosecution of which Sir William, with a prescience that has kept his memory green, proved statistically that England had all the natural advantages necessary to ultimate success; Portugal and Spain having been pushed aside, the Netherlands reeling from the blows received and preparing to give way to France as the coming challenger of England's growing greatness. They precipitated the tremendous struggle, which, fought out to the bitter end on the plains of India, on the waters of the Mediterranean and the Spanish Main, on the Gold Coast of Africa, on the ramparts of Louisburg, on the Heights of Quebec, and along the valley of the Ohio, determined for ages the destinies of the world. With that struggle began the re-creation of Germany, its intellectual supremacy over the continent of Europe, its political union under the leadership of Prussia and its kings; the independence of the United States, and "the foundation of the unique Empire, which, unlike Russia and the United States equally vast, but not continuous, with the ocean flowing through

it in every direction, lies like a world-Venice with the sea for streets—Greater Britain."*

Under these conditions England had little time and inclination to push those "western sailings of hardy navigators which are our title deeds" to our Northern Island Fringe.

While British troops were occupying Boston in 1769, Samuel Hearne of the Hudson Bay Company was making his first attempt to find copper on the Coppermine River, an attempt, in which at the end of three years, during which he travelled 1,000 miles on foot or in canoes, he was to achieve success and to be the first white man to look upon the Arctic waters from the interior. As he describes the occasion, the weather was decidedly unfit for extended observation; a thick fog and a drizzling rain greeted him as he stood on a small eminence near the mouth of the river, cutting his name on a board in sign of the extension of the Hudson Bay Company's possessions to that point, else he might possibly have looked across the waters and seen the great island now called Prince Albert Land and included in the District of Franklin.

Though the English were not much in evidence in Polar seas during the 18th century for the reason that it was a fighting century with 194 battles as its record, Davis Strait did not lack visitors. The Dutch prosecuted the whale fisheries so vigorously that between 1719 and 1775 they had made nearly 6,400 voyages, an average of over 100 vessels a year.

The second decade of the century now nearly run out had not wholly passed when the English began to bestir themselves.

The Peace of 1814 had freed England from her American entanglement. With the battle of Waterloo had ended Napoleon's career as a conqueror.

Barrow is a frequent place-name in our Arctic possessions and along our northern littoral. Barrow Strait; Cape Barrow in Victoria Land; in Grinnell Land; in Coronation Gulf and near

*Professor Seeley: "Expansion of the Empire."

the Great Fish River; Mount Barrow between the Coppermine and the McKenzie River: Barrow Bay in Parry Islands; Barrow Island, Barrow River and Point Barrow are instances. Parry, Richardson, Ross, Beechy, Back, Belcher, and Kane were the givers. There is a Barrow Bay in Corea and a Barrow Bay off the north west coast of Australia.

Sir John Barrow, in whose honor these many place-names were bestowed, was an ardent advocate of Arctic explorations. He wrote a great deal in favor of further investigation, believing that if a passage were found it would be of immense service to Great Britain in her commerce with India. He succeeded in arousing public interest in the resumption of efforts to solve the problem.

Parry's voyages and Franklin's followed, Barrow cheering them on; his position as Secretary of the Admiralty Board—a position he occupied for forty years under eleven first Lords of the Admiralty, the esteemed confidence of all of whom he held as well as that of King William IV—enabling him to lend a helping hand. Before he became Secretary, he was employed to settle the Government of the Cape of Good Hope, and published two volumes on that important acquisition, whose name has been so prominently before the Canadian public of late. The perusal of that work induced Lord Melville to appoint him Secretary of the Admiralty, and thus to give him a position where he could exercise strong influence in favor of Arctic exploration. When our boys landed in Cape Town a little while ago, they landed in a colony that had been established by the man whose memorial tablets are scattered all over the Canadian District of Franklin.

Sir John Barrow—he received his baronetcy for his work in connection with Arctic exploration, like so many others knighted for service in the Arctic regions of Canada—Sir John Barrow used his great influence in a practical manner; for by reason of his efforts the Parliament of Great Britain in 1818 passed an act for the promotion of polar discovery, by the terms of which a reward of £20,000 sterling was offered for making a North West Passage and of £5,000 for reaching latitude 89° north, while the Commissioners of Longitude were empowered to award proportionate sums to those who might achieve certain portions of such discoveries. Barrow lost no time in securing four vessels, two

to go by way of Spitzbergen, Cabot's favorite way, and two *via* Baffin Bay. The first were under the command of Captain Buchan and Lieutenant Franklin, being the first time the latter officer made a trip to the Arctics. The second two were under the command of Captain John Ross and Lieut. E. W. Parry. Both expeditions sailed in April, 1818. It was in these circumstances that John Ross came to be connected with our Arctic Island District.

Ross coasted along the west shores of Greenland, bestowing place-names all along the coast. When he arrived at the southern end of Smith Channel he named the two opposing capes—one on Greenland and one on our territory—Cape Isabella and Cape Alexandria, after his two vessels. He sailed south, naming the bays and islands and inlets he explored, and returned to England with the intelligence that the north water of Baffin Bay was a good spot for the whale fisheries, and it was accordingly utilized for many a year, bringing much profit to the nation.

In 1829, Ross, by the assistance of Sir Felix Booth, made a second voyage in which he entered Prince Regent Sound and went south along the eastern side of a land he named Boothia Felix. On August 16th he wrote in his journal, "I went on shore with all the officers, took formal possession of the new discovered land and at one o'clock the colours were displayed and the King's health drunk, together with that of the founder of our expedition after whom the land was named, Mr. Sheriff Booth, an old and intimate friend." Brown Island was named "after the amiable sister of Mr. Booth," and the harbour was named Port Elizabeth "in compliment to a sister of the patron of our expedition." He wintered in Boothia. He subsequently named and partially explored King William's Land to the west of the Peninsula of Boothia and passed two more winters in that region. As he could not get his vessel out he went to Fury Beach, where he passed his fourth winter, 1832-33. Eventually he and his men were picked up by a whaler in Barrow Strait and taken to England. I have counted more than 200 names conferred on places in Franklin territory by John Ross.*

*Mr. Otto Klotz reminds me that Sir James Clark Ross, who was with his uncle, Sir John, on this expedition discovered (10th June, 1831) the position of the North Magnetic Pole on Melville Peninsula.

John Ross's second in command, was, as we have said, W. E. Parry. As Parry did not concur in the view held by Ross about the passages, reported by Baffin, being mere *inlets*, but believed that they were *straits* by which a North West Passage could be found, he was appointed to command another expedition, which sailed in the leafy month of May, 1819, and was formed of the "Hecla" and the "Griper" with a hundred men on board. With these vessels he entered Baffin Bay and passed through Lancaster Sound, the continuation of which he named Barrow Strait. He also saw and named Wellington Channel, after the Iron Duke, then Master-General of the Ordnance. Pressing onward he saw and named several Islands after his much loved western counties, for he was a Somerset man. On the 4th September the ships crossed the Meridian of 110° west of Greenwich in latitude 74°44′, by which fact the crews became entitled to the reward of £5,000 offered to those first reaching that meridian. To do honor to the joyful event, a bluff headland, off which the announcement was made, received from the men the name of "Bounty Cape."

He came at length, after a voyage of 300 miles from Wellington Channel, to land which he named Melville, in honour of Lord Melville, First Lord of the Admiralty, who, to judge of him by the frequency with which his title appears as a place-name (there are ten or a dozen places bearing his name) must have been a man whose heart was in the right place. Here further progress was stopped by that impenetrable polar pack which seems to surround the Archipelago, and was compelled to winter in a harbor on the south coast of Melville Island, called by him Winter Island. Parry was the first of the "hardy English navigators" whose "westerly sailings" we are following, to winter in our north country. There they wintered in a dark silence, broken only by the loud resounding blows which the hammer of intense cold now and then strikes upon the beams and sides of their ships—otherwise a silence so profound that one might easily fancy he could hear the clash of constant battle kept up in his veins and arteries—those great military roads leading from and to the citadel of the heart—as the microbes, friendly and unfriendly to human life, make of his body a battle-field, in which the prize is his continuance in health or his removal to the silence of the tomb. When the long Arctic night

of three months', over 2,000 hours, duration fell upon the two ships, Parry, to give amusement and at the same time edification, established a weekly paper, a theatre and a school, an example followed by later winterers in those regions. The paper was edited by Capt. Sabine, the eminent observer, and was called the "North Georgia Gazette and Winter Chronicle." It may have been a spicy journal, but I doubt if it had a "Frills" or an "Inez," to chronicle the doings and dresses of society's dames and damsels. The editor certainly had no news from far off lands. The Duke of Richmond, Governor-General of Canada, had a short time before died of hydrophobia in a barn near Ottawa and his remains had been buried with great pomp and ceremony in Quebec. England was seething and bubbling over with riots and outrages in its manufacturing districts; starving agricultural laborers were burning hay ricks and her people were migrating to Canada aud other countries by thousands. But of these Editor Sabine knew nothing and therefore could tell his readers nothing. He could tell them of the pale bright light of the moon, of occasional paraselenas, of the brilliant splendour of the Auroras, the constant presence of stars and the meteoric flash of ærolites and other celestial appearances, rather than of mundane matters. Possibly many a good story of thrilling interest was gathered from reminiscent Jack Tars, and many a witty paragraph evolved from the surroundings. The Prince of Darkness may have received special attention, for the region must have seemed his special realm, with darkness on the face of the land and the icy lanes.

The Theatre Royal opened with the play of "Miss in Her Teens" on the 5th of November, the same day the sun sank beneath the horizon not to rise again for nearly three tedious months. The fur-coated, yet very cold, audience sat it out and enjoyed it, for it is written "that when the actors advanced and hurrahed for old England, the whole audience with one accord rose and gave three of the heartiest cheers I have ever heard." In May following Parry undertook a journey across Melville Island and records that "the soil was in most cases barren, with occasional pieces of coal embedded in sandstone, but on the western coast vegetation was more abundant and game more plentiful."

In August the vessels went westward. A high and bold coast was sighted and named Banks land, and then, the ice pack preventing further progress in that direction, the vessels' bows were turned eastward, and the ships' company examined, as they pushed their way along, the southern coast of Melville Sound and Barrow Strait. Parry had sailed upwards of 30 degrees of west longtitude beyond any former navigator, and had seen the most westerly lands of the now called District of Franklin. In due time he arrived in England.

Sir John Barrow, commenting on this voyage says, 'We are proud, and justly proud of the name of *Cook*, but we venture to assert, without fear of contradiction and without meaning to derogate one tittle from the merit of that renowned navigator, that in no part of his career of discovery had he occasion to call into action all those personal exertions and mental energies which were perpetually demanded in, and essential to the safety of, the late expedition.''

Parry made a second voyage as commander in 1821, going to Repulse Bay and exploring some 200 leagues, nearly one-half of which belonged to the continent. He wintered near Winter Island in Repulse Bay and established a theatre, where, on the 17th of November, ''A shivering set of actors performed to a great-coated, shivering audience, the appropriate play of the ''Poor Gentleman.'' He went up the east coast of Melville Peninsula guided by the tracings on paper of a remarkably intelligent young Eskimo woman, whose untrained hand took as naturally to drawing as the hands of others of her tribe did to pilfering. He named the strait which separates the peninsula from the island north of it the ''Fury and Hecla'' strait, after his vessels. He did not succeed in finding a North West Passage and returned to England. Nothing daunted, the British authorities sent out three expeditions—one by way of Behring's Strait, the second under Parry by Baffin Bay, and the third under Franklin by land, to the continental shores of Northern America. Parry did little, his vessel, the ''Fury'' was wrecked and he returned to England ; his future acts, not being associated directly with Canada's archipelago of the north, concern us not.

I have quoted Sir John Barrow's opinion of Sir. Ed. Parry. You will see on the map between Coppermine River and

McKenzie River, Cape Parry. In bestowing the name upon that bold headland, Dr. Richardson, in 1826 wrote in his journal, "Cape Parry I have named after the distinguished navigator, whose skill and perseverance have created an era in the progress of northern discovery."

While Parry was taking possession of the islands of what is now known as Parry Archipelago, another ardent Arctic explorer was at work seeking to ascertain the bounds of the northern shore of this continent. This was the man in whose honour, and in that of his noble-hearted wife, twenty place-name tablets have been set up in the Queen's Arctic territory.

Sir John Franklin first became connected with Arctic exploration in 1818. He was born in Lincolnshire, April 16th, 1786, and was intended by his father for the church. But one day he and his companion seized the opportunity of a holiday to make a jaunt of a dozen miles to see what the ocean looked like. That day's enjoyment of the salt water aroused in him the determination to become a "salt." His father, thinking that a good solid experience of the discomforts of life in an ocean ship would make the boy long for the quiet of a parsonage, sent him to Lisbon on board of a merchantman. But the intended cure only confirmed the disease, and in 1800 when fourteen years old, the youngster was on the quarter-deck of the Polyphemus, a 74 gun ship, which a few months later led the line in Nelson's great naval battle of Copenhagen. During the next few years he was knocking around the world as is the custom of sailor lads. He was in Australia, where his vessel was wrecked, in India, in Portugal, in Brazil and in the Gulf of Mexico performing those duties which a young English naval officer in stirring times has to put his hand to.

When peace came after the battle of Waterloo, the young lieutenant sought and obtained an appointment on board a vessel in which it was proposed to attempt to cross the pole by the often tried way of Spitzbergen. The qualities which the young officer displayed recommended him to the London men who had polar enterprise at heart, and in 1819 he was placed in command of an expedition whose object was to find the Arctic Sea by the overland route through our North West Territories, then known as Rupert's Land.

There was not much known of our Arctic Coast at that time. Samuel Hearne, as we have already seen, had discovered the Coppermine River, and thus had become known as the first white man to visit our Arctic shores. Though it was not part of his work to investigate the ocean, there is no doubt that he realized that he was looking on water that was salt. He was a salt water mariner as well as land traveller.

When Franklin was a "wee" baby of three summers, Alexander McKenzie was forcing his way down the valley of the "Big River" as it was called for many years till Franklin himself gave it the name it now bears—McKenzie River—in 1825, as he stood on the eminence from which McKenzie, 36 years before, looked upon the great ocean of the North, the first white man to do so.

Excepting the mouths of the McKenzie and the Coppermine rivers, nothing was known of our Arctic Coast line when Franklin and his companions set foot on our shores at York Factory in Hudson Bay and began organizing their expedition. His first winter was spent on the banks of the Saskatchewan. During the succeeding summer he was treading closely in the steps of Hearne down the Coppermine River, from the mouth of which he explored the shores of Coronation Gulf to the east, as far as Point Turn Again, a distance of over 550 miles.

In his second overland expedition, he and Dr. Richardson divided their forces at Point Separation, he himself going down one of the eastern mouths of the McKenzie river delta and exploring within 160 miles of Point Barrow, the cape which Beechy reached in 1826 coming through Behring Strait. Richardson explored the coasts between McKenzie River and Coppermine River. As he stood upon a cape on the south shore of Dolphin and Union Strait (named after his two boats) Richardson saw to the north a great land and named it Wollaston Land "after the most distinguished philosopher, Dr. Hyde Wollaston."*

*Most of Wollaston's papers deal more or less directly with chemistry, but they diverge beyond that science on all sides into optics, physiology, botany, acoustics, astronomy, and even touch on art. He discovered the metals palladium and rhodium. The Royal Society awarded him a Royal Medal for his process of manufacturing platinum—a work, which, in its immediate effects, it is almost impossible to over-estimate since it made platinum crucibles generally available, thus supplying analytical chemistry with the most powerful instrument of advance.—Ency. Brit.

It was on his return from this expedition that Franklin visited Ottawa, and on Col. By's invitation, laid well and truly the Foundation Stone of the first lock of the Rideau Canal between Parliament Hill and Nepean Point.

In 1837-8-9, Dease and Simpson completed the examination of the coast, connecting Franklin's furthest west with Beechy's Point Barrow, and Franklin's and Richardson's furthest east with the Isthmus of the Peninsula of Boothia, establishing for the first time, beyond question, that there is a water passage all the way from Behring Strait to Boothia. Dr. Rae made a land journey in 1846 and 1847 and connected Dease and Simpson's work with the work of Parry.*

A year or two before Rae, with his companions, in the accomplishment of this work, wintered in Repulse Bay without fuel, subsisting for twelve months by hook, gun and spear, tramping on foot for 700 miles, and making the first long sledge journey of nearly 1,300 miles made in that part of our district of Franklin; Franklin himself had left England (1845) with the "Erebus" and the "Terror" on that memorable "westerly sailing" from which he never returned—neither he nor his seven score of companions, nor their vessels.

When he had been gone for three years and no tidings of him had been wafted by favouring breezes to waiting, expectant England, great anxiety began to be felt there. In 1848, Sir James Ross was sent to search for the missing expedition. He went to Lancaster Sound and wintered near north Devon, making in the spring of 1849 a long sledge journey with Lieut. McClintock for his companion. Being unsuccessful he returned to England with the sad news. All England was aroused. More than 130 British seamen were lost and their fate must be as-

*In 1853-4 Rae, by a sledge journey of over 1,000 miles, connected the work of Dease and Simpson with that of Ross.

certained, if possible. England has never spared men or money when her subjects are imprisoned and need to be set free whether they are held in bondage among the mountains of Abyssinia or in the "thrilling regions of thick ribbed ice."

In all, I have counted 22 expeditions which were sent to Polar regions to assure their countrymen that all was being done that skill and energy could do to lift the veil and reveal the fate of the captain and men of the "Erebus" and the "Terror." By these, during the years 1850-54, nearly the whole of the vast Archipelago of the district of Franklin was thoroughly searched.

The kindred nation to the south of us generously lent a helping hand, Moses Grinnell, of New York, equipping two expeditions, one in 1850 and the other in 1853, to aid in the search. In commemoration of his efforts we have added to the large stock of place-names Grinnell Land and Grinnell Island to mark our gratitude and to remind future generations of the large-hearted man who acted on the adage "blood is thicker than water" that has more than once been invoked between the two nations in times of need.

France, the other kindred nation of Canada's people, was represented in the search by Lieut. Bellot of the French navy, who went as a volunteer with Capt. Kennedy. The gallant Frenchman was drowned, and his deeds are commemorated by the place name, Bellot Strait, which he discovered, and thus established the most northerly coast of the continent; and by a marble tablet affixed to a cenotaph erected in Wellington Channel near the place where he lost his life.

Collinson and McClure went by way of Behring's Strait. Penny and Austin entered Barrow Strait from the east. Sir John Ross, then a veteran of 73 years, wintered near Penny, off the south coast of Cornwallis Island. Years before he had promised Sir John Franklin that if the occasion arose he would go in search of him, and now the time for the fulfilment of the promise having fully come, the brave old man, scorning ease when his comrade's fate was the problem to be solved, was at his post amidst the rocks and ice of Franklin District. Kennedy with Bellot was sent out by Lady Franklin herself.

Sir John Richardson* and Dr. Rae, at the instance of the Hudson Bay Co., searched in 1848 the continental shores over Richardson's old route between the McKenzie and Coppermine Rivers, and later on Dr. Rae examined the shores of Victoria Land.

The earnestness with which the search was prosecuted is seen in the fact that on Christmas Day, 1851, eight vessels were in different parts of the District of Franklin frozen up. Some 400 brave men under the ablest arctic explorers were passing the time of darkness as best they could, patiently waiting for the sun's return so that they could scour the islands by means of sledge parties. The plan of campaign was carefully prepared and closely studied during the 120 days of the sun's absence. When the time came, the sledge expeditions were despatched and the work of searching systematically pursued during the next three or four years. Some marvellous journeys were made by these expeditions that were throwing search-lights over numberless bays and inlets, ever hoping to discover some cairn erected, some *cache* made by Franklin, some recognizable fragments of the "Erebus" and the "Terror" cast ashore along the deeply indented coasts. McClintock was away from his ship for 105 days, during which he covered 1,328 miles. During 94 days Mecham travelled 1,163 miles. Sherard Osborn made 935 miles in 97 days. In a second expedition Mecham made a record journey of 1,336 miles during 70 days' absence.

These efforts resulted in the addition of many islands to the Queen's possessions in the far north and were not altogether fruitless in regard to the main purpose. Traces of the missing ships had been discovered as early as August, 1850, by Penny and Ommanney, from which it was ascertained that Franklin, with 154 officers and men, had spent his first winter (1845-6) on Beechey Island at the south eastern end of Wellington Channel, remaining there at least as late as April 1846.

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*In a letter to his fiancee, Prof. Hurley writes (Nov. 7th, 1851):
"To-day I had the great pleasure of meeting my old friend, Sir John Richardson, (to whom I was mainly indebted for my appointment in the "Rattlesnake"). Since I left England he has married a third wife and has taken a hand in joining in the search for Sir John Franklin, (which was the more dreadful?) like an old hero as he is, but not a feature of him is altered, and he is as gray, as really kind and as seemingly abrupt and grim as ever he was. Such a fine old Polar bear." Richardson was 62 years of age when he set out on this overland expedition.

After that, years had to pass before further information was obtained, though Belcher had gone through Wellington Channel and examined the Victorian Archipelago, discovered North Cornwall, North York and North Kent, and connected them by Belcher Channel with Jones Sound and Baffin Bay; though Kellett and Vesey Hamilton had found their way to the North shores of Prince Patrick Island, threading with swift movement, but with ever watchful eyes, the mazes of the furthest North West of Franklin District; though McClure had penetrated Prince of Wales Strait, and from his wintering place of Princess Royal Island had despatched sledging parties north and south and east into Prince Albert and Victoria Land; though Collinson had carried his vessel into Victoria Strait and had come to within a few miles of the spot where Franklin's vessel had been abandoned 5 years before.

In 1854 Dr. Rae, then conducting an expedition for the Hudson Bay Co., learned from a band of Eskimos that about four years before some 40 white men had been seen dragging a boat over the ice near the north shore of King William Island. From these "Huskies" he obtained various articles, which he carried to England in 1855 and obtained the reward of £10,000 offered by the Admiralty to the first one ascertaining the fate of the Franklin expedition.

Lady Franklin in 1857 sent out the "Fox," Capt. McClintock, for further search. He was beset in the middle pack of the Greenland coast, and was held fast bound for 242 days and carried nearly 1,402 statute miles. The ice pack was broken up by a fierce storm on 24th April, 1858, and the "Fox" steamed out from among the rolling masses of ice, escaping from thraldom in a most miraculous manner. After eight months of aimless, helpless drifting hither and thither, McClintock found himself clear of his floating prison and ready to make a beginning in the task Lady Franklin had set him. During the autumn of 1858 he arrived at Beechey Island, and there erected to the memory of Sir John Franklin and his companions, the marble tablet already mentioned as having been provided for the purpose by Lady Franklin. Then he turned his vessel southward into Prince Regent Inlet and wintered in Bellot Strait. By the middle of February, 1859, he was able to start on his first

sledging expedition, the thermometer 48 degrees below zero. As a result he obtained clews from the Eskimo, which led him to return to his ship and to despatch three expeditions, by which evidence, abundant and conclusive, was secured on King William Land, establishing beyond doubt the fate of the "Erebus" and the "Terror." Lieut Hobson, in command of one of these parties, found in a cairn on Point Victory, where John Ross had been on 30th May, 1830, on the north east point of King William Land, a record which read :

"April 28th, 1848, H. M. Ships "Terror" and "Erebus" were deserted on the 22nd. April (1848), five leagues N.N.W. of this, having been beset (by ice) since 12th Sept. 1846. The officers and crew consisting of 105 souls landed here in latitude 69° 37′ 42″, longitude 98° 41′ west. Sir John Franklin died on the 11th June, 1847, and the total loss has been to this date 9 officers and 15 men."

The hand-writing was that of Capt. Fitzjames, to whose signature was appended that of Capt. Crozier, who added, "start to-morrow (29th April, 1848) for Back's Fish River."

From all that can be gathered one of Franklin's vessels must have been crushed in the ice and the other stranded and carried off, bit by bit, by the Eskimo.

The point Sir John Franklin had reached brought him a comparatively short distance from the point he had reached in 1821. He had all but traversed by water the distance between Baffin Bay and Franklin's Turn Again Reef, 160 miles west of McKenzie River.

To Franklin it was plain sailing after he reached (had fate so willed it) the southern extremity of King William Island. Dease and Simpson's, Dr. Richardson's and his own explorations had proved that the water-way between the main land and Victoria and Wollaston lands was navigable in the season. He could have traversed it as easily as Collinson did a few years later. He stood on the verge of the promised land. He saw it but the reward went to others.

What became of the survivors?

There were 105 persons who looked out upon the ice-packed strait on that 29th April, and saw for the last time the ship which had sheltered them for many months.

They had no doubt consulted with Franklin, and had settled what was to be done in the event of having to abandon their vessels. We know that they were on King William Island and that their destination was the Great Fish River. For the rest there is little positive known. McClintock found proof that some of them had perished along the shores of King William Island. Other evidences indicate that the main body of them had succeeded in reaching Montreal Island in the estuary of the Great Fish River.

In 1879 Lieut. Schwatka of the United States Army undertook to find out definitely. He and three companions landed at Chesterfield Inlet and proceeded overland from the mouth of the Great Fish River and thence to Cape Herschell on King William Island, whence he examined the west coast of the island to its northernmost cape. Some graves were found and a medal belonging to Lieut. Irving of the Terror, with bones which were believed to be the remains of Irving. These latter were sent to Edinburgh and re-interred there in January, 1881.

One body had been found in a boat by Lieut. Hobson, and some graves were discovered at different times on King William Island. Indications of boat building were observed at Montreal Island, showing that some members of the ill-fated expedition had arrived at that point. It is all mere conjecture from that stage. The only fact is that though more than fifty years have passed since the noble 100 stood upon Point Victory with their faces turned southward, nothing definite has been revcaled. No skeletons have been discovered. No cairns have been found. A few traditions have been gathered from the Eskimo to the effect that white men were seen toiling along and dying in their tracks, apparently of starvation. Possibly some traveller may by accident find the gnawed bones of the men who left Montreal Island on their weary march inland. It was fifty years before the fate of the men on Marble Island was made known to the world, and the chances of discovery in that case were much greater than in the case of the Franklin men.

The result of the several expeditions of the Franklin Relief Expeditions was the exploration of a vast extent of before un-

known country and the tracing of about 25,000 miles of coast line. The various relief expeditions explored as follows :

Sir John Ross in 1849	990	miles
Capt. Austin.....	6,087	"
Belcher and Kellett.....	9,432	"
McClure	2,350	"
Collinson	1,030	"
McClintock, 1857.....	800	"
	20,689	

Much of this had been partially explored by previous navigators, but about 7,000 miles of previously unexplored coast were added by the Franklin Reliefs. In the above statement the miles of coast explored by American navigators and by Lady Franklin's parties (except McClintock's) are not included, nor are the explorations of Dr. Rae.

When McClintock withdrew his ship from the mazes of the District of Franklin, the exploration of the District had been nearly accomplished.

After that England lost interest in Arctic exploration, and for fifteen years the British Government did nothing for the advancement of geographical research in north Polar regions, leaving that kind of work to English yachtsmen, to Austrians, Germans, Swedes, Norwegians, and Unistoniams, the latter confining themselves chiefly to our side of the pole ; the others giving their attention to the Siberian side.

On the map far to the north, you will see Ellesmere Land, Schley Land, Arthur Land, Grinnell Land, Garfield Coast and Grant Land, separated from Greenland by Smith Sound, Kennedy Channel, Robeson Channel and Lincoln Sea. Ellesmere Land and Smith Sound were named by Baffin in 1615. Then till 1853 no white man is known to have explored the region. In that year, nearly 240 years after Baffin's voyage, Dr. Kane, (U. S.), explored the Sound and went through Kane Basin into Kennedy Canal. He was followed by Dr. Hayes of the United States in 1860, who reached 81° 35′. Capt. Hall (1871-2) received assistance from Mr. Robeson, Secretary of the U. S. Naval Department, and passed through and named

Robeson Channel, the northern continuation of Kennedy, reaching 82° 16'. By these, and other Unistoniam explorers, the northern extensions of Baffin's Ellesmere Land and Smith Channel were explored and named, and thus it is that in the north-east corner of the District of Franklin, we have a curious combination of place names, commemorative of British and American worthies, suggestive of that closer association of recent times which seems to prognosticate the union of the several branches of the English-speaking people, after a few more presidential elections have eliminated the amusing tendency to "tail-twisting" our breezy neighbours periodically display, owing, apparently, to a deep seated provincialism not yet eradicated.

I have mentioned that the District of Franklin has had its free schools, its free theatres and its free newspapers, and also its own currency (gun wads). It has also inspired great painters. "The North West Passage" exhibited at the Academy in the Spring of 1874, was perhaps, the most popular of all Sir John Millais' paintings at the time, not only for its intrinsic merit, but as an expression, more eloquent than words, of the wide felt desire that to England should fall the honour of laying bare the hidden mystery of Canada's North. "It might be done and England ought to do it." This was the stirring legend which marked the subject of the painting.

Capt. Trelawney, who in his younger days had been an intimate friend of Byron and Shelley, sat for the "old sea-dog," whose weather-beaten features gave utterance to the sentiment nearest his heart. By his side is outspread a map of the Northern regions, and with her hand resting on his hand, his daughter rests at his feet, reading to him the records of previous attempts to reach the North Pole.

This picture powerfully assisted men like Sherard Osborn and others, who had been connected with circumpolar exploration during the "fifties," in their efforts to induce the Government to try again. After 15 years of inaction, in the autumn of 1874, the Prime minister, Benjamin Disraeli—that bright and morning star of the Imperialistic principle, whose steady light has guided the British people to Imperial unity—announced the

intention of the Government to send an expedition in 1875. The ships equipped for the purpose were the screw steamer the "Albert" and the "Discovery," under the command of Capt. Nares, whose experience had been gained in the "Resolute," Captain Kellett, in 1852-4. With him were Commander Markham, Captain Stephenson (commander of the "Discovery") Lieuts. Aldrich, Parr and Beaumont, and Capt. Fielden. Capt. Nares encountered great difficulties, but he pushed his ships up Smith, Kennedy and Robeson Channels, and wintered in the "Alert" in 82° 27′ north latitude, the highest point of wintering ever attempted to that date, the "Discovery" being some miles to the south. In the spring of 1876, the explorers made several extended sledge journeys under Commander Markham and Lieuts. Aldrich and Beaumont. Aldrich explored 200 miles of the north and west coast of Grant Land, going as far as Cape Alfred Ernest (named after the Queen's second son). Markham and Parr boldly pushed out straight for the North Pole, and reached the highest point up to that time attained, viz., 83° 20′ 26″ N., or 38° north of Ottawa, say about the distance between Halifax and Glasgow.

You will see the names of many of these navigators on the chart of the most northerly regions of Canada—Nares Land, Markham Island, Aldrich Bay, Beaumont Island, etc.

We can trace here and there in the older provinces of the Dominion the influence of these Arctic explorations upon the thought of the people.

In Ontario we have Parry Sound and Island named by Commander Bayfield, R. N., who made a survey of Lake Huron and Georgian Bay (1822-25.) and named the Sound after Parry, the fame of whose exploits as an Arctic Navigator in 1819-20 had naturally attracted Bayfield.

McClure township in Hastings County was named in 1857 after Sir Robert LeMesurier* McClure, R. N., the Arctic explorer. McClintock township in Muskoka perpetuates the fame of Sir Leopold McClintock, whose name also appears in many

*In his most interesting book "Nothing but Names," Mr. Gardiner gives the name as Robert J. McClure. This is a mistake.

places on the map of our Arctic regions. There are several Franklin's in the Provinces, for Franklin's fate was discussed around many a fireside in British North America in the "fifties."

It may be asked by an utilitarian age *cui bono*? What is the good of this District of Franklin? Let it pass away from our memories. It is a deserted mausoleum, strewed with the graves of heroes, if you will, but is there any money in it? I answer (1). Half a dozen years ago people said, "Canada is the land of waterfalls, but what is the good of them. They are in out of the way places. What is the good of having seven millions of horse power in falls and chutes when they cannot be utilized?" A German student in the quiet of his laboratory discovered that spruce made the best pulp for paper. To-day, after wasting their strength for centuries to no practical purpose, except here and there driving a saw mill, the waterfalls of Canada are in great demand for pulp-making purposes, and there is scarcely a fall in all the broad land but has been bought up or is the subject of an option for purchase.

I answer, (2) Look at Yukon territory. A few years ago when we took the census of 1891, we did not think it worth while to send an enumerator into any part of the vast territory known as Yukon. We simply delegated the Hudson Bay Company's people at Fort Liard to keep count of the Indians from the regions watered by the Upper Liard, the Pelly and the Yukon rivers, who came to the Fort for the purpose of trading. Now in nine years' time there are, I am informed, 15,000 or 20,000 persons grubbing for gold along the rivers, streams and creeks of that great district. Banks, churches, schoolhouses, gambling dens and homes abound, and we will have to organize as complete a staff for census purposes for Yukon as for Prince Edward Island. Who knows what the future has in store for the district of Franklin? We know that the musk ox abounds, for McClure's men in the term of their captivity in Bay of God's Mercy shot 112 of the great shaggy animals on Banks Land, while further north on Melville Island the musk ox finds a congenial habitat, and still further north Peary shot the shaggy bovine for his Christmas dinner. Deer abound. Wolves are

numerous. Fish are in plenty. The Eskimo designate it "the land of the white bear."

Anthracite coal has been found in different parts of the District. Pure copper in large masses was found in the possession of the Eskimo of the Island. Vast petrified forests, capable of being utilized for the adornment of the homes of civilization have been found. Sir Edward Belcher tells of thermal springs and of gold found in North Cornwall. Indications of mineral oil are mentioned by some explorers. It was because of applications for gold areas in Southampton Island that Hon. D. Mills considered that a special transfer of the Island should be made to Canada.* Even those most steeped in utilitarianism will admit that there are possibilities to excite their jaded powers in these but partially explored regions.

I have left to the imaginations of my hearers the trials and dangers, the exciting events experienced by these Arctic explorers in thus discovering the boundaries of the District of Franklin. From many instances I take but two or three as specimens.

Captain Lyon sailed from England in the "Griper" in midsummer, 1825. In August he made the high land of Southampton Island, and rounding its southern extreme stood up the "Welcome." As they advanced northward their compasses became useless. A heavy sea swept incessantly the crowded decks and a thick fog like a pall covered everything. Three bower anchors and a stream anchor were let go, but before the vessel was brought up by these the water had shoaled to five fathoms and a half. Momentarily expecting that the ebbing of the tide would cause the vessel's destruction, they prepared the boats, and every officer and man drew his lot with the greatest composure although two of the smaller boats would have been swamped the instant they touched the seething waters. Hour

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*I have merely indicated the more material of the utilities connected with the Arctic possessions of Canada. I have not attempted to point out the advantages to the world at large to be gained by polar exploration, associated as it is with a true understanding of geology, meteorology, terrestrial magnetism, and of those departments of science which deal with the flora and fauna of the globe and need the elucidations that are supplied by knowledge of the plant and animal life of the polar regions.

after hour the decks were flooded, drenching the poor fellows to the skin. The weather clearing a little, a low sandy beach was seen just astern on which the seas were breaking fearfully. Had the anchors parted no human power could have saved them.

Although few of the men had any idea they could ever survive the gale, Lyon ordered that every man should put on his warmest clothing and secure some useful instrument about his person.

"Each, therefore, brought his bag on deck and dressed himself and in the fine athletic forms which stood exposed before me," says the narrator, "I did not see one muscle quiver nor notice the slightest sign of alarm. Prayers were read and then all sat down in groups, sheltered from the wash of the sea by whatever they could find and some endeavored to obtain a little sleep."

"Never," says their gallant commander, who had not been in bed himself for three nights, "never, perhaps, was witnessed a finer scene than on the deck of my little ship when all hope of life had left us. Noble as the character of the British sailor is always allowed to be in cases of danger yet I did not believe it to be possible that among 41 persons not one repining word should have been uttered. Each was at peace with his neighbour and all the world and I am firmly persuaded that the resignation which was then shown to the will of the Almighty was the means of obtaining His mercy. God was merciful to us and the tide fell no lower." Very appropriately was the scene of this affecting narrative named the Bay of God's Mercy.

Another eventful day in the history of the District of Franklin was the 6th of April, 1853. Sixty-six men were on that day in the "Investigator" encased in ice in another Bay of God's Mercy on the north coast of Banks Land. They had not had a full meal for twenty months. They were reduced in strength from the attacks of scurvy. They had just lost by death one of their messmates. The ship's stores had been carefully doled out to them and they were supplementing the dole with arctic mice cutlets and other luxuries. In their extremity they had resolved upon breaking up into parties to set out in their weak emaciated condition, one over the ice to the north-east, another overland to gain the north shore of the main land and thence to journey to

the mouth of the McKenzie River for the nearest Hudson Bay Company's post, while the third party was to remain with the ship. While four men with heavy hearts were digging the grave, a figure was observed approaching on the ice from the northward. The figure proved to be Lieut. Pim of H. M. "Resolute" from Melville Island "who had most providentially reached the "Investigator" after a most severe and harassing journey of 28 days." Dr. Armstrong, who died in July 1899, describes the event: "I cannot attempt, he says, to convey any idea of the scene which took place on board or the expressions of joy and gladness which were so abundantly poured forth when the intelligence that flew with the rapidity of lightning from stem to stern became known. It was at first pronounced either a mistake or a joke. Indeed the mind for the moment appeared confused as if unable to comprehend the truth of what was heard and several strange involuntary questions were hastily muttered, asked and answered in a breath. At length when thoroughly aware of the reality and fully aroused by a shout of joy raised by a few men on deck, announcing the approach of the strangers, there was a sudden and simultaneous rush to the hatchways, the weak and the strong, the maimed, the halt and the blind following each other, amazed and agitated, as fast as their enfeebled limbs could bear them until the deck was gained and they were afforded an opportunity of verifying what they had just heard. Some as doubting the reality of what they saw, rushed out on the ice and were not satisfied till they met Lieut. Pim, touched him, handled him and heard him speak when they no longer doubted. He was the first of our countrymen we had seen or whose voice we had heard for three long and dreary years. The sledge soon followed and the party were received by three as hearty cheers as ever came from the lungs of British sailors. No words could express the feeling of heart-felt gladness which all experienced at this unlooked for, this most providential arrival. Relief was now at hand; succour had reached us."

I have heard from Bedford Pim's own lips the story of the meeting, told with modesty and yet with conscious pride that he had been the instrument of the rescue.

The 25th August, 1854, is a day long to be remembered in the annals of Franklin District. The crews of the "Investiga-

tor,'' who had entered on their fifth year of arctic service, were that day on board the '' North Star '' at Beechey Island. With them were the crews of the '' Resolute,'' the '' Intrepid,'' the '' Assistance,'' and the '' Pioneer,'' all five vessels having been abandoned, all waiting the order of Sir Edward Belcher to cast off from the ice floe on their homeward voyage. The order was given, and just then the faint outlines of two ships were seen through the haze. They proved to be H. M. ships '' Phœnix '' and ''Talbot'' from England, bringing with them letters for many of the crew. The men were at once distributed among the three vessels, which immediately proceeded on their course. We can imagine the joy of the men on that day.

THE HURONS OF LORETTE

The French travellers and missionaries who explored the basin of the St. Lawrence at the beginning of the seventeenth century, found, within that vast area, two distinct races of aborigines :

(1) The Algonquins, nomadic hunters, roving over the lower valley and the northern highlands ;

(2) The Huron-Iroquois, of more sedentary habits, with some development of agriculture, a better defined and more solid organization, settled in the region of the three great lakes Ontario, Erie, Huron.

The Hurons numbered twenty thousand people or more, and their villages covered the land from the shores of Lake Simcoe to those of Georgian Bay. It is from this point, that after its overthrow by the Iroquois, a portion of the Huron nation repaired to Quebec, and finally took root at Lorette,* where they still form a separate group.

Throughout some northern townships of Simcoe County, remains of Huron occupation have been for sixty years past, and are still at the present time being found : ancient village sites are discovered, bone pits are brought to light, fragments of primitive pottery are unearthed.† Meanwhile, at Lorette, the observer is confronted with debris of a very different character : social traditions still persistent and to quite an extent impressing the minds and moulding the lives of French-speaking descendants of the primitive Hurons.

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*On the map attached, the location of Lorette is shown by the sign x.

†A. F. Hunter, Sites of Huron Villages, Appendix to the Report of the Minister of Education, Ontario, 1898, 1899.

The Iroquois were a confederation of five tribes, whose settlements, south of Lake Ontario, extended in an almost straight line from the Genesee River to the sources of the Mohawk and Hudson rivers in the Adirondacks. From a few of these tribes, the Jesuits, subsequent to 1667, gathered the foundation stock of a colony which still exists at Caughnawaga, near Montreal.*

Last summer, guided by the LePlay and de Tourville method of social enquiry, I attempted an investigation into the social conditions of the Hurons of Lorette. I endeavored to ascertain, as fully as the short time at my disposal permitted, the present status of the community, the degree of its variation from the primitive type, and the influences which brought about this variation.

I also visited the Iroquois of Caughnawaga with a view to securing a ready point of comparison.

PHYSICAL FEATURES.

In order to obtain an insight into the social characteristics of any human grouping, it is necessary, first, to investigate its means of living ; and these, in almost every case, will be largely dependent on the natural resources of the locality. Let us then see what are the physical features and resources of the country surrounding Lorette.

The first fact to be noticed is the situation of Lorette at the meeting point of two great regions widely different in the relief and composition of their soil, as well as in their natural capabilities and productions.

On the one hand, to the South, towards the St. Lawrence, a relatively narrow belt of flat, low country, through which the River St. Charles slowly winds it course to its estuary at Quebec. The soil of that champaign region is generally deep, fertile and specially well adapted to agricultural pursuits, as evidenced by the fine expanse of cultivated fields interspersed with comfortable farm houses, cosy villages and glittering church steeples which one may observe from the elevated terrace of Indian Lorette, while in the distance, some ten miles away, loom up the busy suburbs of Quebec, the cape and the citadel.

*On the map, the location of Caughnawaga is shown by the sign ⊙.

On the other hand, to the North, along the upper course of the St. Charles, lies a strip of level but rather poor, sandy soil, and the country then merges into a vast mountainous tract which extends to Hudson Bay and the Atlantic Ocean, interrupted only by the valley of the Saguenay and Lake St. John. That North Laurentian mountainous region presents a succession of rocky, rounded summits, cut by narrow valleys, with sparse, limited areas of shallow soil ; a land well adapted for the production of fine timber, especially for the growth of the coniferæ, and originally an unexcelled thriving ground for the fur-bearing animals, but over the greater part of its extent offering little inducement to agricultural settlers, who only of late years have taken a foothold within its borders.

If we compare the geographical position of our Lorette Hurons with that occupied by their ancestors in the vicinity of Lake Simcoe, during the first half of the seventeenth century, we cannot fail to notice their close similarity. Although separated from East to West by an interval of nearly 400 miles, and though the one is 150 miles (2 degrees) to the South of the other, both points lie alike at the very edge of that same Laurentian formation, betwixt mountain and plain, with a vast natural hunting ground on the one side, and deep soils inviting tillage on the other.

Neither is this to be looked upon as a mere coincidence. Such a position would commend itself to people of the Huron-Iroquois type, relying for their maintenance, on the produce of the chase and, in about equal measure, on that of a rude, primitive agriculture.

If we glance at the map here given, we will observe that while the various groups of that stock had their fixed abodes within the champaign region bordering on the Great Lakes, none was very far distant from mountainous tracts, some of which even up to this day, have remained typical breeding grounds for wild animals. Two instances are particularly striking : (1) Next to the ancient habitat of the Hurons, that sportsman's resort of today, the Muskoka and Parry Sound country ; and (2) close to the old Mohawk settlements, the famed Adirondacks, the one and the other resting on the rugged Laurentian formation.

It may be broadly stated that the champaign region is made

up of two varieties of soil : (1) a belt of rich clays, bordering on both shores of the River St. Lawrence ; (2) a belt of poor sands, bordering on the mountain ranges.

The Hurons of Lorette, though still within the flat, or champaign region, are not on its inner, fertile zone, but on its outer sandy zone. At their village, called Indian, or Jeune Lorette, the line of demarcation between the two zones is very apparent. Here the River St. Charles passes through a steep and narrow gorge, to a lower level. From the terrace on which Jeune Lorette stands, if we look down the course of the St. Charles, there appear to us on the dark rich loams, in close succession, the farms of St. Ambroise, Ancienne Lorette, Charlesbourg, Ste. Foye and Beauport. On the contrary, should we turn northward and ascend the course of the St. Charles, farms would no longer be observed on the sandy riverside, but instead an after-growth of spruces, and the summer villas of some professional men of Quebec.

At Caughnawaga, nine miles from Montreal, on the opposite shore of the St. Lawrence, where thrives a community of some 2000 Iroquois, the physical conditions are not at all similar to those amid which the Hurons of Lorette have been made to develop. In fact they are almost the complete reverse.

The champaign region, and, with it, its inner fertile belt of marine clays, on both banks of the St. Lawrence, increase rapidly in width as we proceed from Quebec to Montreal. In a general way these are described by Canadian geologists as covering a triangular area, the apex of which is towards Quebec, while the base runs from Ottawa to the head of Lake Champlain. It will thus be seen that Caughnawaga stands in the centre of a wide plain, is surrounded on all sides by a flat country provided with a rich soil.

It may be added that the mountainous region which bounds the plain to the South-East, is of slight altitude, and underlaid not by very hard granites and schists, like those of the Laurentian formation, but by softer rocks, limestones and slates, of the Cambrian and Silurian series, which by weathering have yielded abundant and generally rich soils. So that wide ranges of this mountainous country are well adapted for farming and at an early date were taken possession of by agricultural settlers.

In fine, while the natural conditions surrounding the Hurons of Lorette may be summed up as follows : nearness of vast mountain and forest tract, limitation of tillable area ; the position of the Iroquois of Caughnawaga, on the contrary, is characterized by the development of the fertile belt and the limitation of the mountain and forest tracts. These two sets of physical conditions have had far reaching effects on the evolution of the communities swayed by them, and, first, on their systems of labour, as we will see presently.

LABOUR.

As the traveller from Quebec reaches by the Quebec and Lake St. John railway, the village of Indian Lorette, the means of living of the inhabitants are vividly revealed to his senses. On the right, he cannot fail to notice an extensive field covered with poles and rails, on which hides in great numbers are hung up to dry. To the left, between the railway track and the River St. Charles, he observes some fifty houses, nearly all alike : small, low-roofed, wooden buildings, whitewashed, in double rows separated by narrow lanes. On small plots adjoining some of these houses, hide-drying scaffolds and hide-dressing apparatus similar to those just noted, only on a smaller scale, are visible. Some houses have very small kitchen gardens attached ; but others are so close together, that not even space sufficient for a flower garden remains.

I visited several of these houses, and found them to be as many workshops, or as many homes of workers performing various tasks and turning out various wares on their own account, or for the benefit of an outside employer who provided the raw material and paid his help wages by the day or piece.

While some of the men were engaged, at Bastien's, or Cloutier's, or Ross' tannery, steeping the green skins in water, and then scraping off the inner (or meat) layer, and the first outer layer (with the hair) ; another class of workmen, on the same grounds, following up the process, washed the skins in soap emulsions, put them up to dry, sprinkled them with codfish oil, sand-papered them, and finally passed them through a smoking house.

Meanwhile, in the workshop connected with each establishment, the boss, or skilled workmen under his supervision, cut out

of the thick, velvety, odorous surface of the dressed skin, the various pieces, bottoms, tops and uppers, required for the manufacture of moccasins.

These several pieces are then distributed among the women, at their homes in the village, some of whom embroider the top pieces with moose hair of various tints, while others undertake the turning up and wrinkling of the bottoms, and others still sew on the uppers.

The moccasins are then returned to the workshop of the employer, where with the aid of a few simple machines, holes are punched through the uppers, eyelets and hooks fastened on. Laces are made from strips of the hides, and the moccasins packed and shipped to distant points.

At other times, we might find the men in large numbers busy making snowshoes, bending into shape the slender wooden frames and weaving in the strings. Again, occasionally, we might be attracted by the sight of a newly-made, freshly painted, canvas canoe, drying in the sun on the verandah of some cottage.

I had not been long in the village of Lorette, before three or four dark-eyed children ran up to me and offered various small wares. Bright little girls were they, not easily fooled and quick at sales. I was taken by them to their parents' homes, and there viewed displays of ornamental baskets, canoes, fans, etc. Men were leisurely preparing strips of ash and discs of various woods, which the women and grown-up girls use in the making of the baskets and fancy wares.

While gazing upon the display of wares at the house of Prudent Tsioui, I made the acquaintance of another Huron, who was working for him, Daniel Gros-Louis. The latter, does not manufacture on his own account, but works by the day at the various industries carried on in the village ; and his principal vocation is accompanying, as guide, city sportsmen on their annual outing in the woods. That evening I hired Gros-Louis to take me a few miles up the St. Charles, and as we glided slowly, in the dusk, over the dark waters of the picturesque forest-fringed stream, he told me in language at times forceful, of the woes of the poor Indians, despoiled of their hunting grounds by the encroachments of the white settlers and the leases

to clubs. Gros-Louis stated clearly that in his opinion there are only two decent kind of people: first, the Indians, like himself of course, then the "gentlemen," who occasionally help the Indian on. As for the "habitants," they are a stupid lot, who work hard and ignore the pleasures of life.

The Huron villagers do not seek any appreciable part of their income from agriculture, nor even from those more simple opportunities offered by country life. Only three or four families keep cows (one each), and a few hens. The others purchase from French farmers the very milk and eggs they consume. Only one keeps horses.

However, being informed that on a reserve 1600 arpents in extent, two miles distant from the village, a few Hurons were settled on farms, I started out, one morning, on my bicycle, rode through the village of St. Ambroise (adjoining Indian Lorette), down to the lower plain, along a range of good French Canadian homesteads, and soon coming once more upon a stretch of sandy uplands, was apprised that I had reached the Indian reserve.

The six or seven Huron families settled here (though they may occasionally turn out a few pair of snowshoes) do not resort to industry in at all the same measure as do the Lorette villagers. They are supposed to depend principally on farming, but can hardly be considered farmers. Much the greater part of the Reserve is still bush. Each farm comprises only a few arpents (at most ten or twelve) of cleared land, on which, at the time of my visit, the only growth to be observed, apart from a small garden and potato patch, was a miserable field of very thin hay, overrun by oxeye daisy. In rare instances, a crop of a few bushels of oats might be added. When farm animals were kept at all, the stock consisted of one cow (exceptionally two), one horse (if any), one or two porkers and a few hens. Attracted to one of these homesteads by the rather better appearance of the house and barn, compared with the hovels on most of the other clearings, I was disappointed to find that the husbandry there carried on was of the same undeveloped, primitive type. I did not see any stock, but was met by the fierce barking of three or four dogs coming out in succession from under the door steps. "They are very good hunting dogs," the people told me by way of apology.

For the Hurons of the Reserve, a more important, and certainly more congenial means of living than agriculture, is hunting. Beaver, otter, marten, mink, cariboo, are still in fairly large numbers over the vast unsettled track which extends towards Lake St. John; but moose, the most valuable for manufacturing purposes, is scarce now.

Just as Gros-Louis had done the evening previous, the Tsiouis of the Reserve bitterly complained of interference with their hunting privileges on the part of the whites, through governmental regulations and leases to clubs. Forest rangers were on the look-out, and frequently confiscated the pelts and destroyed the traps of the poor Indians.

The resources derived from their farms and their hunting expeditions are inadequate for the support of these Hurons, and they would be in utter misery, were it not for some additional revenue obtained in various ways: drawing firewood from the reserve to the Lorette villagers, day labour performed on the railway and elsewhere in the vicinity, and oftentimes, the very material help provided by their women folk. The occupant of the first house I entered on the Reserve, was an old man supported partly by a son living with him but working for a baker at St. Ambroise; and partly by a daughter, who kept his house and did some sewing for outsiders.

Now and then a Huron will leave the village or the Reserve and spend a few years in the United States, employed as common laborer, when he will return to his former home.

To sum up the labour system of Lorette: Hunting is today of little account, except for very few of the Hurons; but a number of the men hire out periodically as guides to parties of sport seekers from the cities. Farming is not carried on to any appreciable extent. The only important means of living are manufacturing industries, such as the making of baskets and of various fancy wares, the making of canoes and of snowshoes, and above all, the making of moccasins and the dressing of hides therefor. It is to be observed that the hides used in the manufacture of moccasins are for the greater part imported East India elk and antelope. Of the skins the produce of the region, moose has become scarce, cariboo is suitable only for mittens, gloves and the

uppers of moccasins ; cow, for snowshoes. Neither is fine birch bark commonly found within reasonable distance, and canoes (of which about 25 are sold yearly) are mostly made of canvas purchased at Quebec. Ash wood for basket-making is also obtained from distant points.

On the other hand, moccasins and snowshoes are sold by the wholesale to dealers in large towns and cities throughout Canada and in the United States. They are shipped as far as the Klondike. As for baskets and fancy wares, part of the output is disposed of in the same way, the bulk of what remains being taken by the Hurons themselves to summer resorts and centres of population, and there retailed.

The means of living of our modern Hurons as just described, do not at first sight appear to have any connection either with the previous social status of the race, or with the physical features of its present habitat.

With the ancient Hurons, as with the ancient Iroquois, hunting (carried on by the men), agriculture (carried on by the women), were the principal means of subsistence ; to-day at Lorette, both these forms of labour have been almost given up. In their stead manufacturing industries have grown and come into prominence, industries, however, which do not depend for their raw material on the resources of the locality, and which find in the vicinity a market for a very small portion only of their output.

Two main series of facts brought the Hurons by degrees to give up their old forms of labour and adopt new ones :

(1) The neighbourhood and competition of settlers from Europe ;

(2) The commercial and industrial evolution.

In the first place, the neighbourhood and competition of white settlers in the vicinity of Quebec had the effect of rendering agriculture more difficult and less remunerative for the Hurons.

The agriculture of the Hurons, as we are aware, was of a primitive kind. It consisted solely in the production through female labour of supplies of vegetables and maize for family needs. No live stock, no beasts of burden were kept. So that, being without the means of manuring the land or drawing fuel

long distances, they were obliged to change their location as soon as the fertility of the soil and the supply of firewood within a limited radius, were exhausted.

In the old Huron country the change of abode, according to Champlain, took place every ten, twenty or thirty years. The same practice was followed by the Huron refugees in the vicinity of Quebec. But here, while the Indians were always free to desert their village site and seek a new one farther in the interior, they were no longer at liberty to retrace their steps. The crowding in of the Habitants around them prevented their moving in any but one direction. From Sillery, the Island of Orleans and Beauport they receded to Ste. Foye (1667), from Ste. Foye to a spot known at present as Ancienne Lorette (1674), and finally from Ancienne Lorette to Jeune Lorette (1697), where they are to-day. Thus were they evicted from the fertile belt of rich lowlands to the sandy terrace bordering the mountain tract. The new conditions were not favorable from the outset to the development in these primitive men of a stronger disposition for agriculture.

As a second result of the neighbourhood and competition of the white settlers about Quebec, the chase also was hampered and curtailed, wild animals receding and becoming scarcer all the time as the settlements extended further back. This second result, however, was effected at a much later date than the first, and not so thoroughly. Not before the close of the eighteenth century or the opening of the nineteenth, do the Hurons of Lorette show signs of discomfort on account of scarcity of game.

Coincidently, a third result was brought about: the development of the traditional home industries of the Hurons, consequent on the decrease of both agriculture and the chase. To make up for the deficiency in the returns from their farm plots and hunting expeditions, they now took to turning out for the trade the various wares which heretofore they had manufactured solely for their family needs. The greater value thereby given to the skins, made up in part for their greater scarcity.

The changes in the labour system of the Hurons of Lorette, thus induced by the neighbourhood and competition of the French settlers, have, of recent years, been greatly intensified by a very powerful factor: the evolution of commerce and industry.

The latter half of this century, and particularly the last twenty-five years, witnessed the rise and spreading throughout Canada of the world-wide commercial and industrial evolution, that is, the introduction of machinery, the building of railroads and canals, the extension of great transportation agencies. Man's powers of production and distribution have thereby been increased a hundred-fold. Distance has been suppressed, so to speak ; and each locality is now afforded the opportunity to develop and pursue on a large scale those industries for which it is best adapted by its natural resources or its social conditions.

The commercial and industrial evolution was the death-blow to some of the minor industries of Lorette, but into others it instilled a new life. Competition put a stop to the manufacture of toboggans and of lacrosses ; but a new industry, fancy basket-making, taken from the Montagnais and the Abenakis, some ten or fifteen years ago, was introduced ; and considerable impetus was given to the making of snowshoes and moccasins and to the dressing of hides. On an average, 10 to 15,000 hides are cut annually at Lorette. In 1898, 140,000 pairs of moccasins were made, and about 7,000 pairs of snowshoes. Instead of the very small family workshop of old, we now see vaster collective workshops run by outside employers of some means.

Not only do the Huron villagers depend for their support almost entirely on the revenue derived from the various manufacturing industries ; but a number quite as large of French Canadians settled in the village of St. Ambroise close by, look to the same pursuits for a living. Snowshoe making is the only industry of the Indians which the Hurons have kept to themselves, not more than two French Canadians being trained in the art.

In turn, this very development of the manufacturing industries reacted on the old forms of labour and caused their further decline. Henceforth, assured of constant employment at easy work, the Hurons gave up almost entirely agriculture, which had long been neglected, and even the chase, which had been dwindling away of late years.

Despite the evolution of their labour system, and notwithstanding a few individual cases of transformation, the Hurons of Lorette as a whole still exhibit traits retained from their primitive social status. For instance, the men, generally speaking,

are not as industrious as the women. They still entertain a dislike for agriculture and steady work. I inquired whether the Huron villagers sought employment at Reid's paper mill near-by. I was told they did not, the reason being principally that "Indians dislike working in factories"; they prefer working at home, or in collective workshops, paid by the piece, and left free to interrupt their work at their fancy.

The forms of labour resorted to by the Iroquois of Caughnawaga, are very different from those in use by the Hurons of Lorette. While the latter community, as we have seen, gets its living almost entirely through the prosecution of a few traditional manufactures which the industrial and commercial evolution has revived, and in which both men and women participate; at Caughnawaga, the men are engaged principally in agriculture, lumbering, quarrying and heavy day labour. It is only of recent years that an industry comparable with that of the Hurons has been introduced: beadwork, carried on by women with material imported from Venice. Lacrosses and snowshoes are also made, but not extensively. The Iroquois of Caughnawaga have the reputation to-day of being hard and steady workers, which the men of Lorette, generally, have not.

This contrast is the more striking in that originally the Iroquois—apart from a slightly superior development of agriculture and a correspondingly inferior development of the chase—possessed a labour system very similar to that of the Hurons, and were broadly speaking of the same social type.

The explanation, to my mind, lies mainly in the diversity of their physical environment for the last two hundred years. See the Hurons, settled at a point of the valley where the arable plain is very narrow, close to a vast mountain and forest tract; the first effect of the advent of the French was to evict the Indians from the fertile belt, to drive them by degrees to the sandy terrace and rugged wilderness at the back, to turn them more completely towards the chase and the industries dependent for their raw material on the chase and the forest; until the day came when the evolution of commerce and industry enabled them to carry on these trades independently of local resources.

On the other hand, see the Iroquois of Caughnawaga, in the centre of a wide plain tillable over its whole extent, far from any

extensive mountain or forest area : the advent of the white settler had not the effect of depriving these Iroquois of arable land (abundant in the vicinity), but it had the effect of cutting them off from their hunting grounds (inextensive and far distant) at the back. Caughnawaga was at an early date encircled by a belt of farm settlements which isolated it from all mountain tracts and restricted the run of the Iroquois. The latter were thus at the outset forced out of the chase, and, at the same time, out of those industries dependent on the chase and the forest. When, many years later, the progress of mechanical arts and transportation agencies made it practicable to carry on manufacturing by means of raw material imported from distant lands, the very tradition of the most important industries (save bead work) no longer subsisted among the Iroquois. Meanwhile the men had been constrained to find other means of living ; they had taken to agriculture.

The social observer who visits Caughnawaga is deeply impressed at seeing still attached to almost every home in that extensive village, a plot on which are grown the very crops described by Champlain, Brébeuf and the early explorers as characteristic of the old Huron-Iroquois agriculture : Indian corn, or maize, pumpkins, beans, tobacco and sunflowers, to which potatoes are added.

About one fourth of the population of Caughnawaga, say 100 families, depend mainly on agriculture for a living. Several of these have under cultivation 100 arpents ; some thirty families work as much as 200 or 300 arpents.

These modern Iroquois, as is here seen, are very different from the primitive type, with whom agriculture did not develop beyond mere garden work carried on by the women folk.

Primitive communities, accustomed to support themselves through forms of labour which consist in the mere gathering of natural products (through hunting for instance), do not willingly give these up for the more arduous pursuits of agriculture. Some sort of constraint is necessary to bring about the change. In the case of the Iroquois of Caughnawaga, it was the deprivation of their hunting grounds which made agriculture a necessity. At the same time, the depth and general fertility of

the soil of the champaign region, no doubt facilitated their passage from the chase to agriculture.

The physical features of Caughnawaga favoured the development of still other means of living among our Iroquois. The nearness of the River St. Lawrence and of the Lachine rapids enabled them to preserve their old-time expertness in paddling bark canoes through narrow, precipitous, river channels. That, in turn, led them to take employment as carriers for the fur trade companies, at the beginning of this nineteenth century and later on, when the lumber trade set in, to become drivers of rafts and to engage in the lumber camps.

Then again, the outcrops of good building stone on their reserve and the construction, in the vicinity, of railways and bridges, afforded them opportunities for earning good wages at heavy work, and broke them into steady labour. At present about 100 Iroquois get regular employment at various tasks on the works of the Dominion Bridge Company, at Lachine.

While thus acquiring to a great extent the white workingman's ability for heavy labour, the Iroquois of Caughnawaga appear to have lost some of their old aptness for protacted running and marching. Not many years ago after taking a crib down the Lachine rapids and leaving it at the "foot of the current," opposite Montreal, a party of fifteen or sixteen Iroquois would walk back to their village, some nine or ten miles away. Nowadays they wait for the next train. Much the greater part of their travelling is done by rail.

In short, while the conditions of physical and social environment at Lorette both tended to keep the Huron away from agriculture, enabling him up to quite recent times to support himself by hunting, kindred forms of mere gathering labour and small manufacturing industries dependent on these; at Caughnawaga, owing to a very different physical environment, the Iroquois was forced to change, to give up the chase, to break himself into farming and like forms of heavy extractive labour.

To-day, if we consider only the forms of labour by which they support themselves and their fitness for steady work, the Iroquois have come nearer to us, have remained less primitive, less savage, than the Hurons.

PROPERTY.

In all communities, there is a close relationship between the forms of labour resorted to and the system of property. Thus, primitive races which get their living by the gathering of natural productions (hunting, collecting, etc.,) do not recognize individual ownership of land, which, on the contrary, becomes a basic principle of societies sustaining themselves by extractive forms of labour, and notably, by agriculture.

The ancient Hurons had but a rude, undeveloped, practice of agriculture, and correspondingly their hold on the soil was of a precarious, limited, sort. Their frequent changes of abode are good proof of that. After their removal to the vicinity of Quebec, they did not, as we know, take more energetically to the cultivation of the soil; on the contrary, under the new conditions, they gave up little by little the practice of agriculture. Similarly they did not develop any greater ability to hold land either privately or collectively.

In the year 1651, the king of France had bestowed on the Christian Indians settled in the vicinity of Quebec (of which the Hurons were the nucleus), a grant of land covering three miles in width on the River St. Lawrence by 12 miles in depth. Of course the Hurons were quite unprepared to take advantage, or retain possession, of such an extent of territory, especially in a part of the country where arable land was rather scarce and much sought for. They allowed themselves to be dispossessed piecemeal not only of the land, but of the seigniorial dues attached to it as well, till they found themselves left with holdings totally inadequate for their support and advancement.

The property held by the Hurons of Lorette, or held in trust for them now comprises:

(1) The Village site;

(2) Adjoining the latter, a Common, covering 8 or 9 arpents;

(3) Two miles from the village, the Reserve proper, 1600 arpents (1350 acres) in extent;

(4) Some 30 miles back, in the County of Portneuf, the Rocmont Reserve, 9,600 acres in area.

(1) The village plot is subdivided into small lots. Each family is entitled to an area sufficient for a house, besides a width of 30 feet in front and 3 feet at the back of that house.

(2) The Common was originally, as indicated by its French name "Clos des Cochons," a pasture for hogs. It still continues to be owned in common by the Huron community, but is now used almost entirely as a hide-dressing ground by Mr. Bastien, who has erected thereon sheds and drying scaffolds.

(3) The 1600 arpents Reserve also remains undivided. It was granted to the Hurons that they might obtain from it their annual supplies of fuel. The greater part is still woods. Six or seven families, as we have seen, have taken up their abode there as farmers, but the farming is of such a primitive character, that it has not been found necessary to trace any boundaries between the various farms.

(4) As for the Rocmont Reserve, it is wholly a distant mountainous forest tract, provided in recent times by the Canadian Government for the support of the Hurons, but neither occupied nor worked by them. However, they derive a small revenue from it, the cut of pine and spruce being leased out every year to lumbermen, and the proceeds paid over to the band in the form of allowances.

It should be observed that all of this property is held *in common* by the Hurons. With them private ownership of land does not exist. Neither have they any desire, as far as I could ascertain, to individually own land. I know only of one Huron to-day who holds privately some land—and not in the Reserve, but adjoining it. In the past as well, cases of private ownership have been exceedingly rare.

In connection, then, with the system of property of the Hurons, what strikes most the social observer, is, on the one hand, the limitation and sparseness of their holdings at Lorette, their place of abode; and, on the other hand, the absence of private ownership of land.

At Caughnawaga, things are in a different way. At an earlier date than the Hurons, the Iroquois had to forsake the chase and to take earnestly to agriculture. As a result, they acquired the notion of property, the desire to have, and the aptness to hold, land collectively, or even privately.

They managed to retain possession of part of the seigniory of Sault Saint-Louis, granted in 1681 for them to the Jesuits. It extends nine miles along the river St. Lawrence, and forms one holding of 12,600 acres. A portion conceded to white settlers yields a revenue of several hundred dollars to the Iroquois community.* Several members of the band have acquired within the Reserve possession of lots covering one hundred or more acres which they transmit freely to their children, although they are debarred from selling or donating them to outsiders. So that as regards the system of property, as well as that of labour, the Iroquois of Caughnawaga have not retained as much as the Hurons of Lorette, of the primitive status and conceptions.

But from this point onwards, the order is reversed. It has just been said that the lands retained by the Hurons at Lorette are limited in extent ; the village where most of the families live, covers only a small area. It is situated along a highway which leads to Quebec, and the French Canadian settlements surround it closely, penetrate it as it were. So much so that at many a point on its outskirts, the Huron homes almost touch those of inhabitants of French Canadian parishes.

That situation puts the small Huron community in close and constant intercourse with Canadians. It opens the doors of Huron homes to the notions and usages of the white settlers.

On the other hand, it has been noticed that the Iroquois of Caughnawaga are still the owners of large areas ; their reserve of Sault St.Louis is a compact holding of over 12,000 acres in extent. Their village (which, unlike that of Lorette, is not cramped for space) is isolated from the nearest Canadian settlements, in front by the wide and dangerous expanse of the St. Lawrence, in the rear and on each side, by a stretch of almost unoccupied woodland. Caughnawaga is indeed a closed group, a community locked up as it were to the rest of the world, and wherein Iroquois manners and traditions have been preserved as in a hot-house.

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*Besides there has been set apart for the Iroquois of Sault St. Louis, a reserve covering 18,500 acres, in the township of Doncaster, County of Montcalm. It is as yet wholly a forest tract which the Iroquois do not work. As in the case of the Hurons of Lorette, the cut of timber is leased to outsiders for the benefit of the Iroquois community.

These features of property at Lorette and at Caughnawaga and the diversity of the conditions of neighbourhood resulting therefrom, will enable us to understand the sudden change of front which presently takes place in the social advance of both our types.

At the start, we found that, taking into account the character of the country inhabited, the forms of labour resorted to, fitness for steady work and ability to hold property, in short all that makes up the *means* of living, the Iroquois was not to-day so much of a savage as the Huron, had more than the latter adopted the ways of his white neighbours. It seems that the parallelism should continue throughout the whole social fabric. However such is not the case.

As soon as we take to considering the home life, the family traditions, the tongue spoken, the entire *mode* of living, then of the two, it is the Huron we find to be, the most completely assimilated to us; it is the Iroquois we find keeping aloof in many respects. That will be made clear hereafter.

Family.

The most striking feature of the family organization of the ancient Hurons and of the ancient Iroquois, was female clanship. The clans—numbering seven or eight among the Iroquois, and as many or more among the Hurons—were vast groupings of people founded on consanguinity, on a common origin. They were not mere local organizations; they were ramified throughout the country. For instance the clan of the Bear, that of the Deer, or that of the Tortoise, had adherents in all the villages, or at any rate in all of the four nations which made up the Huron confederacy. So that, while the people were, for purposes of livelihood, dispersed in distant villages, and for political purposes, broken up into nations, still they were held fast together by the strong bond of the clan founded on family relationship.

A peculiar character of the Huron-Iroquois clanship was that it existed, and was transmitted, not through the men, but through the women of the tribe or family. The Huron child did not belong to the clan of his father, but to that of his mother. In the same way, the possessions of a deceased Huron chief did not go to his sons, but to his brothers, or to the sons of his

sisters, that is to members of his own clan, to which his own children did not belong.

When I visited Lorette, and later on Caughnawaga, I was anxious to find out whether there was left any trace of the old-time female clanship. At Lorette, not only did I ascertain that the clan was no longer a live institution ; but even the memory of it had become very dim. The members of the band whom I questioned on the subject, were not totally ignorant of the clan, but they invariably connected it with male descent. One man, seventy-six years of age, told me he belonged to the clan or "compagnie" of the Deer, because his father had belonged to it. Another claimed to be of the "compagnie" of the Tortoise, also because his father had been of that clan ; and to remove my doubts, he added : "How could I belong to a Huron clan through my mother, who was a French Canadian ?"

One day, I spent a couple of hours chatting with Thomas Tsioui, a typical old Huron (about 80 years of age), living on the 1600 arpents reserve. Three of his sons still living are hunters as much as conditions permit ; he himself spent the greater part of his early life in the woods, and at one time he was a noted long distance runner at the Quebec and Montreal exhibitions. He was very proud of a picture hung up in the best room of his house, a portrait of George IV., a royal gift to Michel Tsioui (my host's father), when as one of the Huron delegation he visited London in 1824. The old man's contention is that the Tsiouis are the only genuine Hurons, all the others being descendants of French Canadians who stole their way into the Huron community. As I objected that the Tsiouis themselves could not claim pure Huron extraction, their mothers and grandmothers in most cases being French Canadian women, the old man argued with great warmth that man, and not woman, the husband, not the wife, made the race. He was seemingly unaware that this was the very opposite of the Huron doctrine, and that his use of such an argument was good proof to me that he was no longer a Huron in respect to some of the fundamental traditions of that people.

At Caughnawaga, on the contrary, I found the tradition of female clanship still quite fresh in the minds of young men as well as old. On one occasion, as I was being rowed across the St. Lawrence by Batiste Canadien and two other Iroquois, I ask-

ed one of them, a man about thirty years of age, if he belonged to any clan. "To the clan of the Wolf," was the prompt reply. "That is because your father belonged to that clan?" I enquired again insidiously. "Oh no," replied the young Iroquois, "my mother belongs to that clan. Clan always goes by the mother, not by the father."

A simple phenomenon which marks the evolution of our Hurons from the patriarchal community and clanship of their ancestors to the restricted family group of to-day, is the adoption of distinct family names, transmitted from father to son. With the ancient Hurons as with the ancient Iroquois, there really did not exist any permanent family names, other than those of the clans. Each individual was given a name descriptive of himself, corresponding to the first name with us, which he did not transmit to his progeny. Each clan had its list of proper names which were its exclusive property; so that every name was not only a personal, but a clan designation as well.* After the missionaries had converted the Hurons to the Faith, they introduced Christian names. But these Christian names, like the former were not transmissible from father to son.

It was in the early years of the present century, that the Hurons of Lorette began to adopt permanent family names. As for the Iroquois of Caughnawaga, it may be stated that even now, as a rule, permanent family names transmissible from father to son, are not in use. In latter years, some families, from coming into closer contact with the whites, have adopted names which are transmitted from father to son: Jocks, Williams, Patton, Jacobs, Phillips, de la Ronde, de Lorimier, d'Ailleboust, Beauvais, Leclerc, etc. But these are mainly to facilitate intercourse with the whites, and their bearers still continue in the tribe to be designated by their Christian names supplemented by their Iroquois appellation. I made the acquaintance of an Iroquois, 80 years of age, commonly designated to outsiders as "Old Sky." His name is "Rowi Karoniontié"; ("Rowi" for "Louis," the Iroquois being unable to pronounce the letter "L"; Karoniontié meaning "Flying Sky"). Karoniontié's son will not in all probability be known

*Ontario Archæological Report, 1900; Connelly.

under the same name. In his childhood he will be designated by his Christian name, to which may be be added the mention "Karoniontié hoek," Karoniontié's son, until he himself be given an Iroquois name indicative of the clan to which he belongs. On account of that indefinite nomenclature, it is not always an easy matter to trace the genealogy of an Iroquois.

For several generations past the Hurons have been marrying white women. The French Canadian wife and mother was a potent factor of transformation at Lorette, and, of course, it was in her particular sphere, at the home, in family life, on domestic usages and manners, that her influence was felt most strongly.

Physically, the Huron type has been altered, though not by any means blotted out. The massive build and high stature which, we are told, were prevalent features among the old Hurons, are not now common at Lorette; neither are the cheek bones and nose unduly prominent as a rule; but the rather dark olive complexion, the almond-shaped eyes and the stiff, flat hair are often observed, and perhaps more so in young children than in grown-up people.

The Huron tongue is no longer spoken at Lorette. French has replaced it. Even the older members of the tribe, in answer to my enquiries, had great difficulty in recalling to mind a few disconnected words. As far back as fifty years ago, the Huron tongue was already out of general use here.

As regards the mode of living, that is food, shelter, clothing, hygiene and amusements, the people of Lorette are no longer Hurons; in these respects their habits are very similar to those of the French Canadians of corresponding classes.

Having to purchase the greater quantity of the food they consume, they obtain it from itinerant traders or from dealers who at the same time supply the French Canadians of St. Ambroise. I happened to take a meal at the home of one of the poorest Huron families on the Reserve, and still remember how I enjoyed that simple lunch of milk, butter and bread, cream and fruit, which was daintily served in clean china or glass and on neat linen.

At Lorette, the houses are not commodious, and they are uncomfortably close together; but generally there is an air of

cleanliness about them, and they nearly all appear to be as well kept as the tidiest French Canadian farmer's or mechanic's home.

The old Huron style of dress has been abandoned. I was able to discover only one member of the tribe, a Huron lady in the nineties, who still retained the traditional costume of the last century, the short skirt with the "mitasses," "leggings" and the moccasins.

At Caughnawaga, also there has been much admixture of foreign blood. Although the physical type of the Huron-Iroquois is more commonly met with and more strongly marked here than at Lorette, I am assured that there are not more than two families of pure Iroquois extraction. In olden times, a good many children captured by war parties of Iroquois raiding the New England settlements, were taken to Caughnawaga and adopted by the tribe. Numbers of the Caughnawagans trace their origin to the Williams, the Rices, the Hills, &c., of Yankee stock. At various times and under various pretences, outsiders, French, Scotch and others, and even negroes, filtered into the Reserve and intermarried with the Iroquois. But most of these foreign elements sooner or later were absorbed by the community and their descendants to-day—though in some cases their physique may tell—socially speaking cannot be distinguished from the other members of the band. The Iroquois of Caughnawaga, in contrast with the Hurons of Lorette, instead of being weakened by foreign intrusion, have been strengthened by it.

Iroquois is still the tongue generally spoken here. About one fourth of the population cannot even speak or understand any other. As you leave the train at Adirondack Junction, half an hour after emerging from the noisy thoroughfares of Montreal, with their flow of French and English physiognomies and their clatter of French and English sounds, you are surprised to find yourself suddenly amid people, in physique and language, quite strange.

You are met by massive, swaithy workmen who salute as they pass with a guttural "Sego. Sego." You proceed up the long rows of small, wooden houses, interspersed with massive stone ones, and a few of a somewhat more modern and decorative style. Some of these are very neat, but as a rule the homes at Caughnawaga did not seem to me as well kept as those I saw at

Lorette. You enter a few of these homes. The furniture is scanty and rude. Your eye catches quaint objects ; you observe a child attached to one of those portable cradles which figure in the accounts of early explorers. You speak to the occupants ; but they are old-timers, they cannot answer your questions either in English or French, but fix on you strange, inquisitive looks. On leaving the dwelling, you find on the beach outside, young men preparing to cross over to Lachine in their long boats. In voluble language which sounds like Greek to you, they are apparently bantering one another. Should you address these young men, they are well able to answer in broken French or preferably in broken English.

In many houses the women are busy at beadwork. Those met out of doors have all a blanket as head covering, even the young misses who look a little more to style in dress, and wear finely shaped tanned leather boots.

Groups of children are playing on the public square facing the quaint church and the old priest's house, the latter dating back to the last century. The lively chatter they are carrying on in their native dialect, is unexpectedly interrupted now and then by some popular American or English tune.

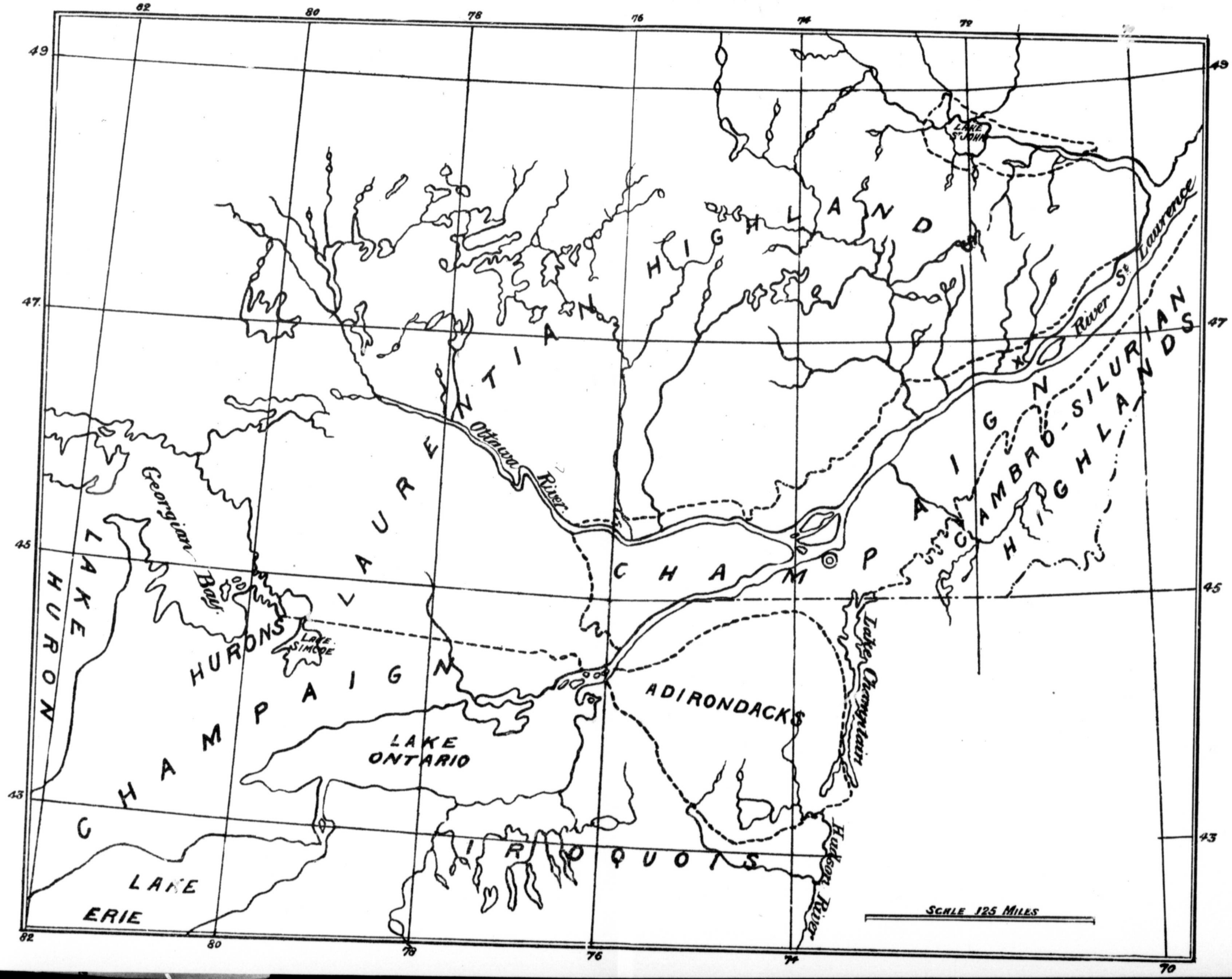
Is there not an element of pathos in the spectacle of these two groups, originally similar, but in the course of time rendered quite unlike under the sway of conflicting social factors? Is it not instructive and interesting as well, to see that Huron, betwixt the fertile plain and the rugged mountain and forest tract, kept back by the influence of the latter in the lower forms of labour and property, but, as a further result, permeated and transformed in his home life through the influence of the French Canadian communities occupying the fertile belt. Is it not instructive and interesting to see that Iroquois, in the centre of the champaign region, constrained at an early date to give up the chase, to take to agriculture and the heavy forms of extractive labour, but, by the very fact, rendered more independent, more isolated, less open, in his home life, to the usages and conceptions of his white neighbours?

We travel abroad ; we seek distant climes to satisfy a vain curiosity for some common-place marvel : would we not find greater profit and interest in applying part of the energy so spent

to the study of Canada? Would we not in that way put ourselves in a better position to work intelligently and efficiently for the welfare and advancement of the people? Would we not thereby become more enlightened and useful citizens, better Canadians?

The Ottawa Social Science Club, whose representative I have had the honour to be on this year's lecture course of the Literary and Scientific Society, has decided to take up, as a primary feature of its programme of work, the systematic observation and recording of social types and conditions in and about the Capital.

LÉON GÉRIN.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CAMBRO-SILURIAN HIGHLANDS
Ottawa River
Georgian Bay
LAKE HURON
LAKE SIMCOE
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Notes on the Study of Language

By W. D. Le Sueur, LL. D.

To man, the thinker, there are three worlds, the world of things, the world of thought, the world of words. Not to speak too metaphysically we may say that things produce thoughts, and that thoughts produce words. Things without thoughts, and thoughts without words, have but an ambiguous existence. Through the use of words we become fully conscious of our own thoughts and of the universe. To whatever we see we are compelled to attach a name, if not an individual one, then a specific or generic one. An unknown animal is at least an animal, an unknown plant at least a plant, an unknown object at least an object. The extreme readiness with which more or less descriptive names are given by uncivilised tribes has often been remarked. Amongst the North-American Indians no visitor has long to wait before he is sized up and named, not always in a manner which he considers complimentary, but always on the strength of some salient external characteristic. The common people have named our wild-flowers, and done it upon the whole very prettily. There is no touch of erudition in such words as daisy, buttercup, heart's-ease, pansy or mignonette, but there is not a little natural poetry. The ignorant will often miscall a word with some element of which they are not familiar, and it sometimes happens that they give us something better than we had before. Our present word "wedlock" was formerly "wedlac," and meant simply "pledge-gift," referring doubtless to the dowries given with daughters; but the old English word "lac," having fallen out of use in the sense of gift, became confounded in the popular mind with the word "lock," which in pronunciation it much resembled; and thenceforth the language possessed a compound of quite different and much superior signification. It is probably not too fanciful to believe that this error on the part of the unlearned has done not a little to

strengthen the idea of marriage as an indissoluble bond. To take an example of another type, the flower which we call daffodil owes its first "d" to a popular corruption; but I do not think anyone to-day would feel disposed to quarrel with the corruption, certainly not anybody who had read Wordsworth's well-known verses ending with the lines:

> "And then my heart with pleasure fills
> And dances with the daffodils."

Language is the measure of thought. What can we *say?* That we have thought. What have we *thought?* That we can say. The rule is absolute: general poverty of language means poverty of thought. He who cannot state a case strongly has not conceived it strongly, has not seized it in its full logical development, has never clothed the bare skeleton of fact with the flesh and nerves and sinews that are needed to make it a thing of life.

It is a great miracle this of language; and it is an impressive fact that it should be possessed by one only of the innumerable tribes of living creatnres. To the human race alone was given the word, to profit withal. Some sections of the human family have not made much of the gift; and yet its possession establishes an absolute gulf between them and even the highest of the lower animals. By others it has been put to better use, and the result is seen in the great systems of thought, the great literatures, and the great civilisations which give dignity and significance to human history. Our forefathers, down to a comparatively recent time, held that language was distinctly miraculous in its origin; and certainly if, as they supposed, Adam and Eve talked excellent Hebrew in the Garden of Eden, they must have been miraculously taught it. What former thinkers overlooked was that the words of every developed language rest on a basis of experience—that no word can have more meaning than experience has put into it, and that the primal pair could not have used a language embodying experiences which their descendants, the human race had yet to gain. Milton tells us that after Adam and Eve had got into trouble over their indiscretion in the Garden, they spent hours in mutual recrimination,

> "And of their vain contest appeared no end."

Of course we allow to Milton a first-class poet's license ; but it is difficult to imagine how the unhappy couple, in their all too brief summering in Paradise, had acquired such an exuberance of verbosity. This line of Milton's may possibly have given rise to a frivolous explanation I have seen suggested of the origin of language, according to which, Adam and Eve having fallen out, "one word led to another" with the result that language was formed.

What seems truly miraculous in language, as we know it, is its wonderful power of adapting itself to all phases of human thought, to every movement of affirmation, denial, or enquiry, to the expression of every posture and attitude of the mind and every variety and degree of emotion. All that Dryden has said in his famous ode on the power of music may be applied to the power of simple words. They rouse to anger and awaken desire and draw forth compassion ; they soothe and they disturb ; they create awe and provoke to laughter ; they come with hope and healing in their wings or send the chill of death into the heart. "Great is their range," as Homer has said, "hither and thither." The mind in its growth has "woven the garment that we see it by."

There is reason to fear that the study of grammar, as it is pursued in our schools, does not place the mind at a favorable point of view for understanding the philosophy of language. It is amusing sometimes to hear the Turveydrops of linguistic propriety discussing questions of pronunciation, accent and grammar as if there were some infallible Beau Brummell to set the fashion in these things, and whose dictum only required to be known to set all such questions at rest. Professor Sweet, in his recent book on "The Study of Languages," says that, when he is asked whether it is allowable, for example, to speak of "an elegant supper," or to say of a sick person "he was bad last night," he is accustomed to answer that English is a free language. He observes also that "foreigners' English often presents the curious spectacle of a language constructed on strict grammatical principles, but with hardly a single genuinely English sentence in it"—a remark which foreigners could doubtless retort on the English when the latter try to write in another language, and have the luck, which will not often happen, to be

"strictly grammatical." In fact, on looking into one of my note books, I find that a foreigner has expressed himself very much to the point on this subject. "No foreigner" says M. Léon Hennique in the "Révue des Révues" for 1 July, 1898, "will ever be able to make entirely his own the special verbal usages of a neighboring people. He may mimic the movement of their language and write with correctness. He may learn the grammar, but he will lack the power to turn round and violate its rules with ease, grace and perfect assurance. He will not have the spirit of the language, which is the soul of those who spoke it in generations past, a kind of knowledge organically possessed and instinctively perpetuated." Professor Sweet expresses the same truth from another point of view when he remarks, in the work already quoted, that "language is only partly rational." If any language were wholly rational, a foreigner could master it just as he could master a mathematical treatise. Algebra is the same in all languages. Like the British constitution, and historic institutions generally, language is a thing of compromises. Men wanted to convey their thoughts to one another, and they did it the best way they could. From the earliest times to the present moment the race has been laboring to mould language to its requirements, and for the most part with little fear of the schoolmaster before its eyes. The work of language making has to be pretty well advanced before Quintilian appears upon the scene. Analogy is the guiding principle in the process; but analogy often goes astray, and then philological knots are tied which all the ingenuity and industry of subsequent ages are incompetent to unravel. The accidents of history too have their say. We can tell a language that has had a rich history from its variously intermingled fossil remains and disturbed stratification. Let us not, therefore, attempt to deal with language as if it were in any sense an absolute system drawn on mathematical lines; but in all our enquiries respecting it, let us take the historical point of view, seeking for facts in the first place, and afterwards endeavoring to explain them.

Formal grammar, as we know, makes much, makes everything, of the parts of speech and rules of syntax. As regards the former some of us, I am sure, in our young days learned to look upon them as having the fixed unanalysable character of chemical

elements, and certainly as being indispensable to the very existence of language. We were certain that Adam knew them in the Garden of Eden, and in all probability named them after he had got through naming the animals. Such is not the scientific view however. Science tells us of a time when there was speech, but no parts of speech. "We are accustomed," says Sayce in his "Science of Language," "to see sentences divided into their individual words, and so we come to imagine that this is right and natural. But the very accent we lay upon our words ought to show us that this is far from the truth. The accent of the word varies according to its place in the sentence; for the purpose of accent we regard, not the individual words, but the whole sentence which they compose." The sentence therefore, is the unit of significant speech and therefore—to quote Sayce again—"all individual words must once have been sentences; that is to say, when first used, they must each have implied or represented a sentence." It would really be more correct to say that words resulted from the disintegration or analysis of sentences, than that sentences resulted from the combination of words.

This may seem a hard doctrine, particularly to those who are in actual possession of a highly analytical form of speech such as the English language; but I am speaking now of language in its earliest stages and not as the finished instrument of the most advanced and intellectual races of mankind. Still the question may be pressed how it is possible, if sentences were made up of a number of distinct parts or articulations, that those parts were not prior in origin to the whole which they composed. In reply let us ask the question which I think is a parallel one: if the human body is made up of various tissues, must not those tissues have existed before they came together to form the body? In both cases we are confronted with one of the mysteries of life and organization. The sentence lives as the body lives; as a whole it expresses a meaning; sever it if you can into parts, and as a whole it dies and the parts die. Everyone knows how much difficulty is experienced in obtaining vocabularies of savage dialects, mainly owing to the fact that the savages, with all the good will in the world, either cannot tell where one word ends and another begins, or cannot give the word you want except in combination with some word you do not want. We need not, however, go to savage tribes for examples of this. Uneducated

persons writing the English language will often detach a syllable from one word and prefix it to the next, or will substitute for a word, the force of which they do not feel, another of somewhat similar sound, absolutely unmeaning as used, but which in some way embarrasses them less than the other. I have often seen the expression "at all" written "a tall," and not long ago I received a letter in which occurred the following: "Had Mr. —— *of* come to me, as he should *of* done, etc." Here "of" takes the place of "have" the force of which was not perceived—at least not perceived in such a way as to prevent its being replaced by an unmeaning preposition. If an earnest missionary from Timbuctoo were trying to acquire a knowledge of the English language from people of this grade of intelligence he would encounter difficulties not altogether unlike those which our missionaries experience in the dark places of the earth.

If therefore we go far enough back, we get to a period when as yet our venerable parts of speech were not. This is just what we should expect according to the doctrine of evolution, which tells us that progress is from the homogeneous to heterogeneous, from the undifferentiated to the differentiated, from the indefinite to the definite, from the unorganized to the organized. Just as our forefathers chipped and polished flints to make axe heads, so —though not with so clear purpose—they would chip away the superfluous parts of a sentence involving some important concept till the concept was isolated in a more or less convenient form. What particular part of the sentence eventually remained in possession of the meaning thus hammered out must, I imagine, have been in many cases a matter of accident. Let us take a modern instance. The Latins had a compound verb "animadvertere" meaning "to turn one's own (or another person's) mind to (something or other)." Owing to the influence of this much-used term the word "advertere" got to be understood more or less as carrying the unexpressed accusative "animum" with it. This "advertere" became the French "avertir," to warn or notify. "Avertir" yielded "avertissement," a warning or notification—in fact an advertisement. Now the word "advertisement" has been cut down in all the printing offices—at least the English ones—of this continent to "ad." Who could have predicted that out of the Latin word *animadvertere*,

or the phrase *animum advertere*, the prefix "ad" would have been chosen to serve millions of people as the designation of a business announcement in a newspaper? I imagine that in primitive times the prize of special and individual signification was often carried off by a part of the sentence that had no more claim to it than any other—no better claim than the syllable "ad" has to express the sense of "advertisement"—a sense which fully developed would be "an-announcement-designed-to-cause-the-public-to-turn-their-attention-to-(Mr. So and So's) goods." A syllable can stand for a good deal when once the lot has fallen on it.

The order in which the parts of speech emerged is an interesting study. Our grammars place the interjection last, but some writers hold that, if the parts of speech were treated in the order of their development, the interjection would come first. This was the opinion of the learned President De Brosses in the middle of the 18th century. Sir John Stoddart also, in his "Glossology" published somewhat over fifty years ago, declared that "Since our emotions precede our judgments, the interjection instead of being the last object of examination should first claim our notice." This is simply an anticipation of the modern view already mentioned that the unit of expression is not the word, but the sentence. Strictly speaking, instead of being a "part of speech" at all, the interjection may be regarded as *the whole* of speech, that is to say as a remnant or revival, as the case may be, of the undifferentiated speech of primitive man. There is much to be said in favor of M. Michel Bréal's theory that the pronoun is really the oldest *part* of speech. The grammatical definition of a pronoun as a word which represents and replaces a noun would not prepare us for this. How could there be pronouns, we might ask, before there were nouns for them to represent? The answer is that signs of demonstration would be almost the first need of primitive man in the way of language. The strictly pronominal use of these words would follow the birth of substantives. Whether nouns preceded verbs, or verbs nouns, has been disputed. The more probable opinion would seem to be that the verb, in its imperative form, came first. In a multitude of cases the same word would alternately be used as substantive and verb. To the thought of our rude ancestors—and here perhaps they were not far from the true nature of things—there would not

seem to be much difference between a term expressive of action (a verb) and a noun. In the fetich age which forms the back ground of all human history inanimate things were freely credited with life and power. The noun, there is reason to think, made its appearance in the double form of substantive and adjective : a thing could express a quality, and a quality could express a thing. It was in a later age that some nouns (names) were told off for exclusive use as substantives and some for exclusive use as adjectives. Next came adverbs formed from substantives and adjectives ; then prepositions which, in the main, are transformed adverbs ; and finally conjunctions, formed from whatever might come handy, and constituting the highest triumph of rational language, as being the most abstract in their nature, and thus the furthest removed from onomatopœia or the representation of things by sounds. The conjunction represents a pure thought. Nothing has so greatly contributed to produce the impression that language must be of miraculous origin as the presence in it of words representative not of things but of mental attitudes. The simple word " if " has started many a profound train of thought.

I have spoken of onomatopœia. In discussions on the origin of language it has held an important place. That it had to do with the formation of not a few vocables there can be no doubt ; and yet the so-called roots of language do not manifest its influence to any greater extent than the developed words we are daily using, many of which are clearly of onomatopœic origin. The late Professor Whitney, however, makes a very true remark when he says that " the actual permanent beginnings of speech are only reached when the natural (or imitative) basis is abandoned, and signs begin to be used, not because a natural suggestiveness is seen in them, but by imitation from the example of others who have been observed to use the same sign for the same purpose. Then for the first time," he continues, " the means of communication becomes something to be handed down, rather than made anew by each individual ; it takes on that *traditional* character which is the essential mark of all human institutions, which appears not less in the forms of social organization, the details of religious ceremonial, the methods of art and the arts, than in language."* It is manifest upon a moment's reflection that

*Encyclopædia Britannica Vol. xviii, page 768.

imitation is at once a very limited and a very uncertain thing. It is not everything that admits of being imitated, and one man's imitation might differ considerably from another's. Above all we cannot imitate thoughts. On the other hand there is no limit to what may be done by conventional and traditional signs; and it is really not until language has assumed this character, that it is marked off by an impassable line from such means of communication as the lower animals possess.

Languages have been classified by philologists—I mention the principal divisions only—as polysynthetic, agglutinative, inflectional, analytic, and isolating. The speech of the Indians of this continent, in both its Northern and its Southern half, is of the polysynthetic order, and is believed to represent the most primitive form of rational human language. Professor Sayce sees herein "a fresh proof that America is in truth the *new* world." In polysynthetic speech a multitude of elements are crowded together in apparently unbroken connection. One word has no difficulty in picking up another, and unions are made which defy analysis. It is by comparison with these languages that we are led to see how abstract, and in a manner artificial, our own language is. To us it seems quite natural that every object within range of our perception should not only be set apart in thought, but should have a term expressive of it in its individuality and isolation. But not so with those who use the earlier forms of human speech: they do not know *things in themselves;* they have never troubled their heads with the *ding an sich.* They know things *as related;* they express things as related. I forget what Indian tongue it was in which the first missionaries could find no separate word for father or son. There were words for *my father*, and *your father*, and *his father*, and the next man's father, all kinds of concrete living or deceased fathers, but no word in which the concept, father, was isolated. So with the idea *son.* There was no word that stood for son simply. When it came therefore to translating for purposes of ritual the phrase "Father, Son and Holy Ghost," the best the missionaries could do was to take expressions which signified "Our Father, His Son and their Holy Ghost." Evidently such a language was very ill-adapted for subtle definition or rigorous argument. We cannot imagine an Augustine, an Aquinas or a Calvin giving his thought to the world through such a medium.

If anyone were to represent to an Indian that his language was very defective in not having any word for father or son, I do not know what the red man would reply, but I know what he might reply. He might say : "You want me to have words for what never existed and never will or can exist." Your reply would probably be : "Not at all ; fathers exist, sons exist." To which the Indian might rejoin : "I never saw or heard of a father that was not somebody's father, or a son that was not somebody's son ; and I don't believe you ever did either. I have all the words I want to describe the things I see around me, and do not feel that I need any others." The Indian might not perhaps conduct the discussion in these terms, but this is certainly the position he would take if he was conscious of his own case. By looking at the matter from this point of view we are enabled to see the really algebraical character of modern analytical speech, in which general and abstract terms stand for *x's* and *y's*. We may perhaps here glean a suggestion in regard to the education of children. We ask them at school to write essays on such subjects as the cow, the dog, the horse, when we do not invite them to higher flights on such elegant topics as virtue, patriotism and friendship. Much more suited would it be to their stage of development it we were to ask them to write an account of some particular cow, dog, or horse they happened to be acquainted with. Then they could speak of what they knew, and could express themselves with conviction. I do not know of anything likely to be more hurtful intellectually, and even morally, than forcing the young to express themselves in vague and unfelt generalisations. The young generalizer is generally a prig and runs the risk of being a humbug.

The agglutinative languages spoken chiefly by peoples of the Turanian or Mongol stock, and of which Turkish is one of the best examples, show a greater separateness in the elements of the sentence than the polysynthetic forms of speech. In the agglutinative languages words are compounded, but are not run together in fortuitous forms and combinations; and the separate parts remain, as a rule, clearly distinguishable. The union is not of that intimate character which produces internal change in the words affected. Instead of such inflections as we see in Greek and Latin, we see words which we would call prepositions affixed

to nouns and thus becoming post-positions. In this manner different cases are formed, but the "post-position" remains distinctly recognizable. Sometimes modifying elements are introduced into the body of a word. To express as briefly as possible the difference between the agglutinative and inflectional languages, we may say that, in the former, words adhere to one another without losing their identity; in the latter the whole inflectional system is founded upon the complete sacrifice of certain words to the function of modifying the meaning or incidence of certain others.

Of the inflectional languages Latin, Greek and Sanskrit are conspicuous examples. How elaborate is the accidence of Latin and Greek not a few of us know to our cost, but Sanskrit in this respect leaves both far behind. The words used to make case or person endings in these languages have been worn down to mere rudiments, the origin of which for the most part eludes all conjecture. What we all know is that, from this intimate union of a root with a modifying element, the cases of nouns and adjectives and the multitudinous forms of the verb came into existence. Meanings which in English it would take two or more words to express are in Latin or Greek expressed by one owing to the fact that the root has been modified into the sense we require by the element it has incorporated with itself. The consequence is that, to some extent, case inflections render prepositions unnecessary. In Latin we can express "eager for fame," "useful to the state," "worthy of honor," "fond of books," "oppressed by care" without using any preposition. Still the preposition was not banished. No system of inflections could be elaborate enough to express all the relations which present themselves to human thought. I think it may even be said that no possible array of prepositions could suffice for the purpose. We probably think we have all the prepositions we want; and yet we often find ourselves using the same preposition in very diverse senses—a pretty sure sign of a deficiency. There was therefore ample work left even by the inflectional languages for the preposition to do; and little as the writers of the Augustan age suspected it, that apparently humble part of speech was designed to destroy the whole case system in the family of languages founded on the Latin.

There were signs even in classic times of the coming change. Suetonius tells us that the Emperor Augustus, partly through a liking for the language of the common people, and partly for the sake of distinctness and emphasis, would sometimes use prepositions where, according to the accepted syntax, they were not required, and where, from the point of view of style, they produced anything but a graceful effect. A similar preference for prepositions is shown in inscriptions of the same period. Our Latin grammars tell us that verbs of giving take an accusative and a dative; but in inscriptions we find such expressions as "Si pecunia ad id templum data erit." The handling of the cases with elegance and accuracy was really beyond the common people. When they were in doubt they played a preposition. The result was that in a popular speech the cases became confused, and prepositions more and more abounded. It is no wonder, therefore, that in course of time the case endings were dropped and the preposition held the whole field.

The Latin and Greek verbs showed inflection to a much greater extent than the nouns, and the Romance languages of today present the same characteristic. The French verb is much more difficult to master than the English. Still, as compared with the Latin, the French verb has been considerably simplified by the use of the auxiliaries *etre* and *avoir*. Auxiliaries are to verbs what prepositions are to nouns: they serve to express the various phases which the fundamental idea of the verb is capable of assuming; and how far they can go in this direction is conspicuously shown in the English language. In addition to the verbs *to have* and *to be*, we use as auxiliaries, *shall*, *will*, *may and do*, and by their united aid get much more work out of our verbs than the Romans, or even the Greeks, could ever get out of theirs.

As compared with Latin and Greek the Romance languages, French, Spanish, Italian, etc., are highly analytic, but it is in English that the analytical principle has received its greatest development. The characteristic of an analytical language is that every thought element in a sentence has its own representative expression. As we utter a sentence in our own tongue—and the same is true in a great measure of the leading literary languages of Europe—we know from moment to moment just where we are, and how much of our intended meaning we have uttered. The

relation between a highly analytic language and a highly synthetic or inflectional one may be compared to that between printing from movable type and printing from blocks. In the analytic languages we have broken up our blocks, so that the different characters they contain may be employed in any place and in any relation in which they may be found useful. It used to be the custom to speak of inflectional languages as being more perfect than analytical ones. The great German scholar, Bopp, in his "Comparative Grammar," seems distinctly to take this view. He speaks for example of the ancient Gothic as being much more "perfect" than modern German, and of Sanskrit as being the most "perfect" language of all by virtue of the extreme elaborateness of its inflectional system. This opinion, I think I am safe in saying, is no longer held either by scholars or by men of letters. We value languages now, not according to the complexity of their structure, but according to their power, compass and flexibility. Judged by this test the English language, with its very slender accidence, can at least hold its own against any other language either of ancient or of modern times. The fact is that, while the English language is analytic in its structure, it is synthetic in its vocabulary; that is to say a given word or phrase is capable of conveying far more emotional effect than could be gathered from its mere definition. There is that involved in it which the heart and not the intellect put there; consequently, while the intellect has come to its rights, or nearly so, in the structure of the language, the heart has many a refuge of its own, many a stronghold, in a subtler synthesis woven of associations, and expressing itself in phrases and cadences whose effects no formal logic can analyse or appraise.

In an analytic language of this kind the power of expression by means of spoken and written words reaches its greatest height. There is a further stage, but it is one of declension and disintegration, that namely which is represented by the so-called "isolating" languages. Of these Chinese and Thibetan are well-known specimens. Analysis has here been carried to its utmost limit. Inflections have gone, grammar is little more than a matter of the order of words, all concords and relations which could give organic unity or vitality to a sentence have vanished. Each word is a naked element. Each is a symbol—that is

all—capable of being used as a means of communication. What the reactive effect of such a language has been upon the people who use it, is a profound and interesting question; and no less profound and interesting is the question as to what the effect would be of the adoption by the Chinese nation of the English language—the only one they conceivably could adopt were they ever to abandon their own. To what extent could they avail themselves of its resources? Would they take from it simply enough to satisfy their present intellectual and moral needs, and deform what they so appropriated? Or would it become to them an educational instrument of inexhaustible potency? One thing seems certain, that it could not for a long time be to them what it is to us; and during that time, there is reason to fear, they would convert it into a dialect of very doubtful character. There are those, indeed, who predict that the future universal language will be pigeon-English. Let us hope that something better may be in store for the world; though it might argue a little conceit to imagine that the best thing for the world would be to have the English language in its present form stereotyped for all time. The Latin language as spoken by Cicero and written by Cæsar was a noble form of speech; but the time came when it was thrown into the crucible, to emerge as French, Spanish, Italian, Portuguese and Provençal. Its transformation was the work of barbarians; but who would say that the barbarians did not accomplish some wonderful results?

Let us now turn our attention to the group of languages to which our own belongs, the so-called Indo-Germanic. It is mainly through the languages of this family that the intellectual progress of the world has been, and is being, carried on. In their history we can trace the history of our own thought. The ancient classical languages had an extraordinary beauty of their own; yet in point of fulness and precision they are surpassed by the leading languages of the modern world, We cannot surpass the beauty—word for word or phrase for phrase—of the lyric and dramatic poetry of the ancient Greeks; still, on the whole, the mind of man has, in the present day, vaster instruments of expression, of analysis and of research at its command than in any former age. Just as the need for precision of thought made itself felt, were the means for securing it developed.

In Homer the relative pronoun—one of the subtlest and most useful products of the mind of man—is unknown. The definite article, as such, is also unknown; so is the indefinite. In Latin, too, the articles are wanting, and though the relative pronoun is in full use (as in later Greek) there is a valuable form of the demonstrative lacking. Horace, for example, says:

"Ætas parentum pejor avis tulit
Nos nequiores."

which literally translated signifies: "The age of our fathers, worse than our grandfathers, has produced us more worthless still." Why did not Horace express himself more elegantly and say "the age of our fathers, worse than *that* of our grandfathers"? Simply because he could not: the word for "that" as here used, and as possessed by the French in the form of "celui," "celle," was lacking to the language. Nor did the Latin ever develop it. Again, while the Greek and Latin languages possessed a considerable number of abstract nouns, these were not as available for use as the abstract nouns of modern speech. Where we should say "from the foundation of the city," "after the expulsion of the kings," one using the Latin language was obliged to say "ab urbe condita," *from the city founded*, "post reges expulsos," *after the kings expelled*, modes of expression which are certainly less logical and less satisfying.

The more closely we study language from the scientific standpoint the more clearly we see how far the best established and most orthodox usages are from having any absolute authority, how compromise and custom have presided over all the settlements of everyday speech. Just as titles to property become more dubious the farther we carry back our researches, so the farther we look back in language the more unsettled things become. If we have a well-established polity to-day in language, it is because those who preceded us tried numberless experiments, fought through numberless difficulties, and made ways for thought which have become smooth and comfortable by secular use. A good example of what I mean is afforded by what we call "case" in grammar. Our Latin grammars speak of six cases; our Greek grammars of five. In English to-day we recognize three cases only, and two of these, the nominative and accusative, are not distinguished from one another in form except in the personal pro-

nouns. Still we recognize the accusative case and talk of its being "governed" by transitive verbs and prepositions. If the question is asked: Why is such a word in the accusative case? the answer comes pat; beeause it is governed by such a verb or such a preposition. But is there any sense in the statement? Strictly speaking there is not. No word causes, or can cause, any other to be in any case. The truth is that there are just two logical positions a word representing a person or thing can be in. It either is or is not the subject of the sentence. If it is the subject all you need to do is to give it its predicate and you have an intelligible statement. If it is not the subject, and yet you require to mention it, you just have to tumble it into the sentence and trust to the use of conditioning words to put it into its right position, that is to make it clear why, and in what relation, you mentioned it. The words that are said to govern it are simply those you employ to make, not the word itself, but its presence in the sentence intelligible. Of itself and by itself it is passive, inert, lifeless. It does not stand erect like the subject and claim a predicate. The other words do not put it into the accusative case, or the passive case, as I think it might better be called; they have come to see what they can do to put it on its legs, so to speak, in some way or other.

Michel Bréal has so well explained the matter in his "Essai de Sémantique" that I should like to be allowed to quote the passage:

"Just as the stones of an edifice, which have long been closely and compactly joined, end by forming one single mass, so in language certain words, as the result of contact, seem to fit into and clasp one another. We are accustomed to see them in juxtaposition; and, through an illusion of which the study of language furnishes many examples, we assume or imagine the existence of some hidden force which brings them into connection and subordinates one to another. Thus arises the idea of a *transitive* force residing in certain kinds of words. Everyone knows the difference between so-called neuter, or intransitive, and transitive verbs, the first expressing a complete action (like *run*, *walk*, *sleep*, &c.) while those of the second class require what is called a complement. The question has been raised, which of these two classes of verbs is the more ancient. To my mind there is no doubt as to the answer: not only are the neuter verbs the older, but we must allow that there was a period when there were none but neuter verbs. Words were created in the first place to have a full meaning of their own, and not to serve the purposes of a syntax as yet unborn. Some of these verbs, having frequently been associated with words which limited their scope by bringing their action to

bear on a certain object, the mind became so accustomed to an accompaniment of that nature, that in course of time this addition, or complement, to the verb came to be regarded as necessary to it. Then, by a mental transfer which finds analogies in other fields of study, men were led to believe that they felt *in the words themselves* that which was the mere result of habit. Henceforth they were in possession of verbs which *required* a complement: the transitive verb was born."

Yes, the transitive verb was born, and an important step was taken towards the establishment of that mutual dependence of words on one another which is the highest characteristic of organized and developed human speech.*

Nothing seems more incomprehensible at first sight than the wealth of inflections possessed by such languages as Greek, Latin and Sanskrit. How did they come into existence? How did the frost pictures which we see on our window panes on cold winter mornings come into existence? They are very elaborate and delicate and beautiful: one might suppose an artist hand had been at work; but if we enquire into the matter we find that all is accounted for by the laws of crystallisation. In the case of the inflections we have, in lieu of the laws of crystallisation, the effort or *nisus* of man's developing thought towards definiteness, completeness, and harmony of expression. Any chance addition to a word, which had in some way or other the effect of causing it to be understood with a certain modification or direction of meaning, might become the foundation of an inflection, and be extended by analogy to other words.†

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*In the paper as read examples were given of the development of intransitive into transitive verbs. Some condensation being necessary in publication, these are here omitted.

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†M. Paul Regniaud, in his able but somewhat too dogmatic work, "Elements de Grammaire Comparée du Grec et du Latin," (Paris, 1896) takes precisely this view. Discussing the question of the origin of "reduplication" in Greek verbs he says: "L'origine du redoublement est sans doute independante de toute préméditation. Il a dû resulter d'abord de combinaisons phonétiques naturelles ou fortuites du genre de celles qui le distinguent, et dout le caractère particulier a été reproduit artificiellement dans la suite pour donner naissance, d'après les procédés analogiques que nous connaissons, à des series de formes nouvelles; et celles—ci out reçu ainsi la figure et la fonction mêmes dont

Take an example from our own language. If any one were asked the sense of the word "up," he would probably say that it signified position or movement away from the earth's centre of gravity. Were he then asked to explain the use of the word in such expressions as "to finish up," "to do up," "to round up," "to size up," he might be a little at a loss to show how they exemplified the meaning first given. On some occasion the word must have been applied to some particular verb in order to fill out its meaning, and, seeming to answer the purpose, it was applied to others. In the inflectional languages certain modifying elements have been not only appended to roots or stems, but have been so completely incorporated with them, that it is now, in most cases, impossible to say what they originally were, or what, if any, independent significance they ever had. Brugmann in his "Comparative Grammar of the Indo-Germanic Languages," a work of the highest authority, states the case as follows: "All the developments of language denoted by the terms stem-formation and inflexion are based upon one common principle, the juxtaposition and more or less intimate fusion of elements which were originally independent. By this process units of speech were formed which in later ages became the types on which new words were made. Many such types or standard forms were in use long before the dissolution of the pro-ethnic Indo-Germanic community." A "stem" may either be a simple root, or a root with some permanent addition to it, to which the inflexional suffix is further added. It is very difficult in certain cases to say whether a given stem is compound or not. Words, like people, are not always as simple as they look. Take a few samples from our own language. Who at first sight would say that the word "cull" was a compound? People who think that all short and pithy words in the language must be of native origin, would likely pick out the word "cull" as an illustration of the strength and brevity of our Saxon roots. In point of fact, "cull" is a compound word of Latin origin; it comes from the Latin "colligere" through the French "cueillir."

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leurs prototypes s'étaient trouvés spontanément investis à l'origine." There is a fine example of spontaneous reduplication in the word "teetotaler"; and the tendency is exhibited in the story of the Western man who asked an English traveller how he had left "Alfred A. Tennyson and Thomas T. Carlyle," adding "They kin sling ink them fellows, they kin."

Or take such words as "aid," "aim," "spy," "daub," "van" or "rest." They look simple enough, but every one is a compound: "Aid" is from Latin *adjutare* through French *aider;* "aim" from Latin *adestimare*, through obsolete French *esmer;* "spy" from Latin *auspicari* through French *epier;* "daub" from Latin *dealbare* through French *dauber;* "van" from the two Latin words *ab ante* through the French *avant;* and "rest" from the Latin *restare* through the French *rester*. Who would suppose that "aim" contained three distinct elements, the preposition *ad*, the substantive *aes*, meaning "copper," and the termination *timo* or *tumo* seen in such words as *aestimo*, *autumo*, *optimus*, etc.? Or that "spy" involved the Latin word for "bird," *avis* and the root *spec* meaning "to see" or "to watch for"? Or that "daub" meant originally to cover over thoroughly with white, having the same origin as the beautiful French word *aube*, meaning *the dawn*, as well as the ecclesiastical term "alb"? Were it not for the link supplied by the French language, it is very doubtful whether the compound character of a single one of these words could be recognized. It is not only in the English language that such contractions occur. The German language contains a very short word "amt," meaning "office," which no one would readily suspect of being a compound; yet, barring the personal ending "or," it contains all the stuff of the very imposing word "ambassador." We may judge from these examples of the extreme difficulty of determining whether certain very ancient Latin or Greek words are simple or compound.

Most suffixes, Brugmann remarks, serve a variety of purposes. This we may observe in English. At a very early date the suffix "ing" was invented, how we do not know. Earle in his "English Philology" says that it originally signified extraction, like the Greek termination "*ides*" in such names as Simonides, Euripides, etc.; but if so it greatly widened its scope in the sequel. Picking up an "l" by being added to words ending in that letter, it sallied forth with this addition, and we soon find it doing duty as a diminutive ending, an entirely new function. Apart, however, from its achievements as "ling," we find it employed to give a collective sense as in the word *shipping*, to express the material of which a thing consists, such as *towelling*, *shirting*, *planking*, etc. In like manner the Indo-Germanic suffix

go or *ko*, as seen in Greek adjectives ending in *kos*, like *physikos*, *logikos*, etc., and in Latin words like *antiquus*, *pudicus*, *unicus*, served when added to substantives to produce a slight modification of meaning, the derivative signifying something tantamount to, or in a general way resembling, the original. "Hence," says Brugmann, it was often used to form diminutives—precisely like our "ing."

An interesting illustration of what can be done by the aid of the *ko* or *ki* element—the vowel in such a case does not count for much—is afforded by the word *reciprocal*, which of course we get from the Latin "reciprocus," or as we ought to call it, "rekiprocus." The first half of the word would suggest the verb "recipere;" but there is no thoroughfare in that direction. To understand the etymology of the word "reciprocus" we must divide it into four parts—re-ki-pro-kus; and we shall then see that it consists of the prepositions "re" and "pro," with the "ki" suffix appended to each, and that its exact signification, therefore is "backward-like, forward-like," in other words, "in a backward direction, in a forward direction." Is not this just what we understand by "reciprocal," *working both ways?*

A very considerable essay could be written on the suffix "ki." As already mentioned it is sometimes used with diminutive effect. Brugmann cites examples from the old Aryan speech as well as from Greek and Latin. A Latin example is *homuncio*, meaning "mannikin," from *homo*; but, as a usual thing, the "ki" in Latin was associated with a second diminutive element "lo." Thus *homuncio* becomes *homunculus*; and the same combination appears in *nubecula*, "a little cloud," *musculus*, *corpusculum*, *cubiculum* and many others. It has been the fate of diminutives in most languages to lose after a time their diminutive force; and sometimes what was once a diminutive will replace and displace the word from which it was formed. The words "spectacle," "article," "receptacle," and many others are diminutive in form but not in sense. On the subject of diminutives in general the remarks of Earle in his "Philology of the English Tongue," are sound and penetrating. "The general motive," he says, "of the employment of such words is to escape conventionality; that is to escape the triteness and dryness of that which is current and hackneyed, and this because the speak-

er longs to mingle with his words something of character or of humour or of good fellowship—in a word something personal and emotional. Now, it is plain without reasoning that to call each thing by the name that everybody calls it, without any little twist or twirl, is apt to seem commonplace and vapid. Consequently there has been found in most languages a faculty of shaping certain words to the temper of the speaker, or, so to say, of giving them a moral coloring. Emotional substantives have been commonly called "diminutives" because the sentiments that have been most active in this work have been those of affectionate partiality on the one hand, or of contempt on the other; and therefore the idea of little has been much felt in this strain of words." This statement of the case may be aptly illustrated by a passage from Robert Louis Stevenson's recently published correspondence. Speaking of Sir Walter Scott he says: "With all that immensity of work and study his mind kept flexible, glancing to all points of natural interest. But the lean hot spirits, such as mine, become hypnotized with their *bit occupations* if I may use Scotch to you—it is so far more scornful than any English idiom." The word "bit" prefixed to "occupations" makes a perfect diminutive, and conveys a delightfully humorous sense of disparagement. The same word "bit," otherwise applied, will be a term of endearment, as in such phrases as "a bit lassie," "a wee bit doggie." In Latin the well-known dying address of the Emperor Hadrian to his soul is a good example of the tenderness of which diminutive forms are capable:

"Animula, vagula, blandula
Hospes, comesque corporis,
Quae nunc abibis in loca,
Pallidula, rigida, nudula;
Nec, ut soles, dabis jocos?"

Latin, upon the whole, is richer in diminutive forms than Greek, yet the Greeks coined many beautiful words of this kind, such as "erotulos" darling, and "eidullion" an idyll. Such words as "nearos" *young*, with its feminine form "neaira," may also be accounted diminutive. Who does not remember the lines in which Milton introduces two diminutive proper names:

"Were it not better done, as others use,
To sport with Amaryllis in the shade
Or in the tangles of Neaera's hair?"

Milton, there can be little doubt, had a sense for physical, as well as for spiritual beauty ; in other words he was a man as well as a poet. The diminutive form most commonly used in Greek —let us keep to our point—is "ion," lengthened frequently to "idion," as in "encheiridion," *handbook*, "oikidion," *a cottage*, and so on. In the "Clouds" of Aristophanes, an idea strikes old Strepsiades, who is learning, or trying to learn, from Socrates to be a sophist, and he cries out, "O Sokratidion philtaton," *O, my dearest little Socrates!* One reason why Greek did not stand so much in need of diminutives as Latin, was that it was freer in its construction and fuller in its forms. Another reason was that its dialects constituted a great resource for its poets. The dramatists in their lyrical passages often dropped into Doric —to adopt a phrase from Dickens—and Theocritus, who wrote wholly in that dialect, found, as Burns did in the lowland Scotch, a vocabulary teeming, if I may use the expression, with emotional values.

Innumerable are the paths which language has made for itself, innumerable as the moods and necessities of the human mind. Some of these paths we can trace, but others are past finding out. As a neat piece of word-making, I do not know of anything better—now that it is all over and our own nerves are not required to stand the shock—than the device the Latins resorted to in order to obtain a word for "all." Was there ever a time, it may be asked, when there was no word for "all" in the Latin language? Yes, there seems to have been, and there must have been a time in the history of every language when no such word existed, for the simple reason that the idea of "all" is a general and abstract one, only to be arrived at by the spiritualization, if we may so call it, of some concrete term. Any one who has ever looked into a Latin dictionary knows that the word for "all," is in the singular, *omnis*, masculine and feminine, and *omne*, neuter, and in the plural *omnes* masculine and feminine, and *omnia* neuter. Now the starting point of this well developed adjective was the nominative plural masculine *omnes*, and this was a contraction of the word *homines*, "men," with "h" dropped in true Cockney fashion. The letter "h" was a stumbling block to not a few in ancient times, just as it is to-day, though the error of using it where it was not wanted was

more common than that of dropping it where it was wanted. Catullus ridicules one, Arrius, for saying "hinsidias" instead of "insidias," and four centuries later St. Augustine said that in polite circles a man was worse thought of who dropped the "h" from the word *hominem*, than the man who hated his brother "homo" with the "h" duly sounded, which is good evidence that this terrible mistake was occasionally committed. "Omnes," having thus lost its "h," it gradually got separated in meaning as well as in form from "homines." and began to serve as an expression for "men in general," or as we might say, "all men." How slight the difference whether we say "homines mortales sunt" or "omnes mortales sunt"! Then all at once it struck somebody that this "omnes" was an adjective meaning "all;" if so it must be capable of being used in three genders and the neuter must be "omnia." But of course in that case it must have a singular too, and that according to rule must be *omnis, omnis, omne*. The thing was too good not to become current, and thus the Latin language was enriched with an adjective meaning in the singular "every" or "the whole," and in the plural "all." Some of the finer spirits—if there were any such at the time—may have winced while this little process was going on, just as some of us would wince if a word were being similarly twisted out of shape under our eyes; but who can deny that, when done, 'twas well done? Now, by the aid of the adjective "omnis," we can form such impressive words as "omnipotent," "omniscient" and "omnipresent," which certainly do not announce themselves as of doubtful origin. The humble "omnibus," to which most persons grudge the first two syllables is from the same source. Attempts have been made by some who, contrary to Pope's advice, have drunk but scantily at the Pierian spring, to give "omnibus" a plural, "omnibi;" but let us not be too scornful of our brethren. Language would have made but little headway in past ages if many such deeds had not been not only attempted, but accomplished. It is safe to say that there is no possible error or solecism, which the classic speech of to-day does not embody and authenticate.

This brings me to the last point which I can venture to touch in this very inadequate treatment of a great subject. Tennyson tells us, in one of his most popular poems, that

"The grand old gardener and his wife
Smile at the claims of long descent."

The worthy couple no doubt know that there is no getting back of themselves, and that they were, on the whole, not much to boast of. If that is not why they are smiling I give it up. Some of you will remember too, what Thucydides says about the origin of the Athenian people. He says that many stories were afloat in his time, tending to show that the Athenians had a very glorious ancestry, but that, as far as he could make out by research, their beginnings were of a very ordinary and common-place kind. Well, as it is with nations and families, so it is with words: trace them back far enough and you come to some-to something very ordinary. Words, like families have their fortunes. Some gather beauty and honor as they come down the ages. and some gather shame and ill-repute. Let us take a few examples. "Curse" and "swear" are very ill-sounding words, but one is only a modified form of "cross," (in its religious sense) and the other is simply old English for "to declare." To "*answer*" is simply to swear or declare back. A "miscreant" is properly one who hasn't the right form of belief—a mis-believer. The word "monster" carries us back to Virgil's

"Monstrum horrendum, informe, ingens, cui lumen ademptum;"

but essentially it means something to point at, or as we might say, a show. "Muster" is the same word modified, meaning literally a "show up," if we may use the expression. We talk of "a good muster," but the adjectives that go with "monster" are all of the most defamatory kind. That popular form of imprecation which the Captain of the Pinafore used so sparingly comes from the same comparatively innocent word which yields us "damage." The word "horrid" meant originally "rough," and "hideous," (Latin, *hispidus*) had a meaning very similar. The word "outrage," which always suggests something terrible, has nothing to do with "rage," its origin is to be found in the Latin "ultra," whence the French "outre," which gives the verb "outrer," *to carry things too far*, the latter in due course yielding the noun "outrage," *the carrying of something too far*. A "demon" with us is a very bad kind of devil; but the daemon of Socrates was something half way between conscience and a guardian angel. The general meaning of the word in classical Greek was "a god,"

"a divinity." The word "ghastly" has picked up an "h" which does not belong to it, and has thereby much improved its appearance for terrifying purposes. Like the Chinese soldiers in their drill it was preparing to look fierce, and now it looks that way all the time—at least it looks "ghastly;" but it meant no more than "formidable" at the first. The word "ghost" has also been trying to frighten us with a stolen "h," and has succeeded pretty well. It has the same origin as the German "geist" meaning *spirit* in the ordinary sense, and is akin to our English "yeast."

Let us take now some very dignified and stately words. "Venerate" and "venerable" are words of the highest character, and move in the very best society; but they both are derived from the name of the most amiable and mirth-loving goddess in the Roman pantheon. What a very expressive word most would say "solemn" is. Decidedly; we catch echoes in it of a tolling bell, or of the fateful words of a judge who has donned the black cap. But after all what does it really mean? Well it means "every year." The Latin word was *solennis*, like *perennis*, the "*ennis*" representing "annus" and "sol" the old Latin adjective *sollus* meaning *all* or *every*. A "solemn festival" is therefore, strictly speaking, one that is celebrated annually. "Glorious" and "splendid" are words that think a good deal of themselves, but if we trace the first back we come to a root meaning "to hear"—indicating that the first condition of glory is noise—and if we trace back the second we come to the ancient term for the spleen, which was supposed to have something to do with the production of bile. "Splendid" therefore meant originally of a bright yellow color. Melancholy is a very sentimental word, but it too had a physiological origin. "Jeopardy" is a word which brings before us the idea of very imminent danger; but at first it had no such meaning: it comes from two French words *jeu parti*, meaning a game in which the counters are distributed equally to all the players. The poet Keats stirs our sensibilities when he speaks of "perilous seas forlorn;" but "peril" is the Latin "periculum" which means literally "a little experience." "Vengeance" is a terrible word, but the "ven" is the same root we see in "vend" and "venal." The word "soldier" calls up the noblest associations of courage, honour, and devotion to duty; yet strange to say, if we go back to its origin it means simply "hireling," one taken into pay, like

the Greek *misthotos*. It would be easy to go on for an hour with similar examples all tending to show that no word ever had, or ever could have had, any very remarkable meaning at the outset. If then we find words having very strong meanings *now*, the inference we draw is that humanity has poured into language the whole wealth of its experience, has told to it, and tried to tell through it, the story without end of its joys and its sorrows, of its struggles, its victories and its defeats, of its satisfactions and disappointments, all the travail of heart and mind and purpose that has marked its pilgrimage through the centuries. That is where language has got its meaning; that is why it is so imcomparable, so overflowing, a depository of the secrets of our race. Through long ages language and the human heart have been pulsing in unison.

It would be interesting to follow out some of the special lines of development by which language as we know it has gained fullness and variety of significance ; and in doing so we could not have a more interesting or instructive guide than M. Bréal in his "Essai de Sémantique" already referred to. My time however is exhausted, and I must close by expressing the hope that what has been said has been sufficient to show that the study of language is full of human interest, and cannot without loss be ignored by anyone who cares to think over again the thoughts of his ancestors, or who desires to estimate at its full value the thought of to-day.

Earthquakes and the Seismograph.

Last Autumn your Librarian, Mr. Klotz, wrote to me asking whether I would lecture before this Society on the subject of the seismograph; and as I felt myself honoured by the invitation, and at the same time feeling a deep interest in seismological investigation, I replied in the affirmative. It was not, however, until some time afterwards, when I received from your President the programme of lectures for the season, that I realized that I had undertaken to give a lecture with a title which would certainly lead an audience to suppose that they were to hear something about the causes which produce earthquakes, as well as an account of the nature and character of the seismological investigation in which our Canadian Meteorological Service is taking part.

I was certainly somewhat appalled at the task allotted me, especially as I conceive that seismic phenomena are most certainly very closely allied to many geological problems; it required some nerve to lecture on such a subject in Ottawa, the home of the greatest and best known geologists of our country. I hope, however, that I shall be able to give you a fairly clear conception as to the causes some of which produce quakes, and can certainly indicate to you some of the methods now followed by seismologists in the intensely interesting researches in which they are engaged. But few of the opinions advanced in the paper can I claim as my own, and I have drawn largely on those of Prof. Milne, Dr. C. G. Knott, and Dr. Agamennone, men who are making seismic phenomena a life study.

There are no manifestations of the forces of nature more calculated to inspire us with awe than earthquakes; few agents have been more destructive in their effects, and to the real dangers which follow these terrestrial convulsions must be added the feelings of uncertainty and dread which arise from the fact that the earth on which we live may at any moment be the agent of our destruction. Even the feeble shocks which at infrequent intervals are felt in portions of our Dominion produce in people a

feeling of alarm. In countries where violent quakes occur, many know from personal experience that calamity may result and others know from history that the whole face of the country may be changed by land slides and sea waves. It is therefore not surprising that some of the ancient Greek and Roman philosophers, who were close observers of Nature, should have come to some conclusions upon earthquakes. Some of these old philosophers recognised that earthquakes played an important part in the formation and configuration of coast lines. In Sir Charles Lyell's Principles of Geology I find that the author has summarised the views held by some of these men. Thucydides describes the effect of earthquakes upon the coast lines of the Grecian Archipelago—Piny supposed it was by earthquake avulsion that islands were naturally formed, and Aristotle states that earthquakes have torn to pieces many parts of the earth, while lands have been converted into sea, and that tracts once covered by sea have been converted into dry land. The writings of Pliny, Aristotle and others testify that they had observed steam and other exhalations escaping from volcanic vents, and held that earthquakes were due to the workings of imprisoned wind and vapour beneath the earth's crust. But while a few of the old philosophers were ready to attribute earthquake phenomena to natural causes, most of mankind then and down through the middle ages could only find an explanation by appealing to the Supernatural, and earthshakings were attributed to the movement of a subterranean god or mythical monster. With the ancient Greeks there was a deity for every natural force, and Vulcan, the deformed son of Juno, was condemned to pass his days under Mount Etna fabricating the thunder bolts of Jove and arms for the gods and heroes of antiquity. Professor Milne tells us that in Japan it is supposed that there existed beneath the ground a large earth spider, which later in history became a catfish ; at Kashima some sixty miles northeast of Tokyo there is a rock which is said to rest upon the head of this creature and keep it quiet. At this place therefore earthquakes would not be frequent. The rest of the empire is shaken by the wriggling of its tail and body. In Mongolia the earth shaker is a subterranean hog; in India it is a mole; the Musselmen picture it as an elephant, In the Celebes there is a world-supporting hog, while in North-America the subterranean creature is a tortoise. The people of

Kamtchatka had a god called Tuil, who like themselves lived amongst the ice and snow, and when he wanted exercise went out with his dogs. These dogs were, it is supposed, infested with insects, and when now and then they stopped to scratch themselves, their movements produced shakings called earthquakes. In Scandinavia, which is essentially the land of mythology, there was an evil genius named Loki who, having killed his brother Baldwin, was bound to a rock face upwards so that the poison of a serpent should drop on his face. Loki's wife, however, intercepted the poison in a vessel ; and it was only when she had to go away to empty the dish that a few drops reached the prostrate deity, and caused him to writhe in agony and shake the earth.

Referring again to Sir Charles Lyell, I find that in 1750 the Rev. John Mitchell observes that earthquakes occur chiefly in volcanic regions, and many other writers of the last century concurred with him that it is to volcanic action that earthquakes are due. Later on Humboldt tells us that earthquakes and volcanoes result from a common cause, which is " the reaction of the fiery interior of the earth on its rigid crust." Professor Hull, Professor of Geology in the University of London, writing as late as 1892, says : "The connection between earthquake shocks and volcanic eruptions is now so generally recognised that it is unnecessary to insist upon it here. All volcanic districts over the globe are specially liable to vibrations of the crust : but at the same time it is to be recollected that these movements visit countries occasionally from which volcanoes, either recent or extinct. are absent ; in which cases we may consider earthquake shocks to be abortive attempts to originate volcanic action." We shall see later however that many geologists and seismologists do not altogether agree with this opinion. Professor Milne says :

" We know from observation that before a volcano bursts into eruption there may be many ineffectual efforts to establish a vent and each of these is announced by a sudden shaking of the ground. The final and successful effort is usually accompanied by movements more pronounced ; and from these observations alone it is reasonable to suppose that at least certain earthquakes are the immediate outcome of subterraneous volcanic action. Should the effort be un-

usually large, resulting in the disappearance of half an island or a large mountain, as was the case at Krakotoa in 1883, and in 1888 at Banaisan (Japan), the earth shaking is correspondingly greater. It is a significant fact that quakes accompanying these great catastrophes do not usually extend over very large areas; for example the area shaken at the time of the Bandaisan explosion was less than 2,000 square miles. If we compare figures like these with those which represent earthquakes some of which originate in non-volcanic districts, and which are repeated many times a year, they are insignificantly small. To produce earthquakes which are felt over areas of five or ten thousand square miles, and which give rise to waves which may be recorded at any point upon our globe, it is difficult to imagine how the primary impulse could have originated at a volcanic focus. Volcanic explosions, as we see them, seem to result from the concentration of subterranean energy at a point; while to shake the whole surface of the globe it would appear necessary that the internal effort should be exerted upon a surface very much larger than we can reasonably suppose to exist beneath a volcano.

"A very much more serious objection to the volcanic origin of the majority of earthquakes is the fact that these disturbances are common in the Himalaya, Switzerland and other non-volcanic regions. An analysis of 10,000 earthquake observations in Japan shows that there have been but comparatively few which have had their origin near the volcanoes of the country. The greater number of this series originated beneath the ocean or along the seaboard; and as they radiated inland they became more and more feeble, until on reaching the backbone of the country, which is drilled by numerous volcanic vents, they were almost inperceptible. Beyond the central range of mountains, earthquakes are only rarely experienced; and what is true for Japan seems to be generally true for the coasts of North and South America."

Geologists tell us that untold millions of years ago our earth was a globe of molten matter, as ages passed the surface gradually cooled—that a solid crust was formed. They tell us of the birth of mountain ranges and ocean depths, how continents have been lifted out of the oceans, and continents have been buried beneath the waters; and we learn that the buckling and bending of the crust of the earth as the cooling goes on is even yet in progress;

that some lands are rising, others falling. Dr. Bell can demonstrate to you that the whole basin of even our Great Lakes is tilting in such a way that, at a not distant epoch geologically speaking, Niagara will cease to exist.

The opinion of the Committee of the British Association for t' e Advancement of Science for the investigation of Seismic phenomena as voiced by Prof. Milne se ms to be that, while admitting a few earthquakes to be volcanic in their origin, the majority of these disturbances result from the sudden fracturing of the rocky crust under the influence of bending, and that the after shocks which so frequently follow large earthquakes announce that the disturbed strata are gradually accommodating themselves to their new positions.

Prof. Milne says: "Strong evidence of faulting being accompanied by earthquake motion is the fact that many large quakes have been accompanied by faults which are visible at the surface. The terrible shock which in 1891 laid waste hundreds of square miles in central Japan seems to have been the immediate result of a great fracture in the earth's crust which can be traced for a distance of over sixty miles. The surface of the ground on one side of this line has fallen some twenty feet below the former level. The main fault was accompanied by many minor dislocations, horizontal displacements and even compression, so that a river bed has been narrowed, while plots of ground which were originally 48 feet in length have had this dimension reduced to 30 feet. In the Neo valley where the devastation was greatest, whole tracts of rice fields on one side of the fault were suddenly lowered relatively to those on the other side. The horizontal displacements and vertical displacements which took place are evident to every traveller throughout the district. A compression of from 1 to 2 per cent across river beds had to be allowed for by the engineers who reconstructed the fallen bridges, while the remeasurement of land for government assessment showed that certain areas had decreased in size. It is no doubt difficult for those who live in districts where such convulsions as these are unknown, to realize these statements, but when they are admitted it is no longer difficult to suppose that such sudden changes could have taken place without serious displacements in the mountains rising from the area where they happened. A tract of country

more than fifty miles in length which carried mountain ranges several thousands of feet in height was suddenly fissured along its length ; accompanying this there was a back spring of strata released from strain and a collapse by falling of a valley bottom and its bounding ridges. The magnitude of this impulse, received almost simultaneously over a large area, caused Central Japan to shake so violently that forests slipped down from mountain sides to block up valleys, while earth waves were created which travelled round the globe."

It is undoubtedly true that earthquake disturbances are not generally accompanied by any visible fracturing on the surface of the ground; but that they may be the result of such fracturing is rendered probable by the fact that they occur in regions where secular movements are in progress, or at least where geological experience has demonstrated that dislocations are numerous.

Professor Milne remarks that throughout the world seismic energy is most marked along the steeper flexures in the earth's crust, in localities where there is evidence of secular movement, and in mountains which are geologically new, and where we have no reason for supposing that Brady seismic movements have yet ceased.

As examples of the flexures to which reference is made, taking sections running at right angles to the coast lines of the various continents, it is found that, taking 120 geographical miles as the unit of distance, on the west coast of South America they slope 1 in 20.2

The Kuriles from Urup 1 in 22.1
Japan, W coast of Nipon 1 in. 30.4
Sandwich Islands, northwards 1 in 23.5
Australia generally 1 in 91
Scotland from Ben Nevis 1 in 158
South Norway 1 in 73
South America, eastward 1 in 243

The conclusion he arrives at from this is, that if we find slopes of considerable length extending downwards beneath the ocean, steeper than 1 in 35, in such places sub-marine earthquakes with their accompanying landslips may be expected. On the summit of these slopes, whether they terminate in a plateau or as a range

of mountains, volcanic action is frequent, whilst the earthquakes originate on the lower portions of the face and base of these districts. Districts where earthquakes, often followed by sub-marine disturbances are most frequent, are regions like the north-east portion of Japan and the South American coast between Valparaiso and Iquiqué. Here we have a double folding, the seaboard as it approaches the shore line, instead of rising gradually, sinks downwards to form a trough parallel to the coast, after which it rises to culminate in mountain ranges. The South American trough which lies within 50 or 60 miles of the coast, like the Tuscarora deep off Japan, attains depths of over 4,000 fathoms, and the bottoms of these double folds are well known origins of earthquakes and sea waves.

The general conclusions at which we arrive are that the majority of earthquakes, including all of any magnitude, are spasmodic accelerations in the secular folding or creep of rock masses; a certain number, particularly those originating off the mouths of great rivers like the Tonegawa in Japan, may result from sudden yielding in the more or less horizontal flow of deeply seated material, the immediate cause of which is overloading by the deposition of sediments; whilst a few which are comparatively feeble and shake but limited areas, are due to explosions at volcanic foci.

It will then be abundantly evident that seismology is intimately connected with geology, with the building up of the land areas and mountains and conversely their subsidence below the waters. The aim of seismology is to discover something further regarding the hidden depths of the globe, knowing that any knowledge gained must be of value—and moreover it is evident from what has already been learned that a knowledge of the depths of the ocean subject to seismic disturbance may be of incalculable value to countries from whose shores cables radiate to far off lands.

For many years there has been a section of the B. A. A. S. interested in the investigation of earthquake phenomena, and the committee of this section has of more recent years had new life infused into it by various scientific gentlemen who have resided in Japan. More than twenty years ago, when the Japanese decided that their country must be a progressive and up to date

country, they invited professors from European universities to come over and fill the chairs in their seats of learning; they invited engineers and architects from Europe and America to come and build their railways and erect their public buildings; and these gentlemen residing in Japan, occasionally felt their houses shaken by earthquakes, and at not infrequent intervals the engineers and architects saw the fruits of their labors wrecked by seismic disturbances. Naturally an intense interest was awakened and a scientific investigation of seismic phenomena was soon in progress.

Prior to 1861 Robert Mallet had studied the velocity of earth waves produced artificially by exploding charges of gunpowder varying between 25 and 12,000 lbs, and somewhat similar methods were employed by Gray, Milne and others in Japan. Professor Milne says: "The shakings were first obtained from the fall from heights up to about thirty feet of a ball approaching a ton in weight and subsequently by the explosion of dynamite and gunpowder in bore holes. The resulting vibrations longitudinal, transverse, and vertical, were recorded at a series of stations so arranged in electrical connection that the time of any vibrations could be noted to a small fraction of a second. These experiments explained many phenomena observed in earthquake disturbances, and directed attention to others the existence of which was for the first time rendered probable. The velocity of propagation of wave motion evidently increased with the intensity of the initial disturbance; it was greater for vertical and normal than for transverse waves; whilst motion was propagated more rapidly to stations that were near an origin than to stations at some distance from the same. The period of the movements increased as the disturbance died out or as it radiated. It was surmised years ago that violent earthquakes occurring at any point on the earth's surface might, if suitable and sufficiently delicate instruments were used, be recorded at any other point; and it has since been abundantly proved that the surmise was correct.

To Prof. Thos. Gray and John Milne belongs the credit of having devised a seismograph that will record the tremors propagated to far off lands.

In the spring of 1897 a letter was received from the chairman of the B. A. A. S., requesting the co-operation of the Toronto

ismograms obtained in various parts of the world illustrating the effect of an earthquake which occurred, on September 3rd,
laska, near Mount St. Elias, in latitude 60° N. and longitude 140° W.
The table shows the latitude and longitude of the points and their distance
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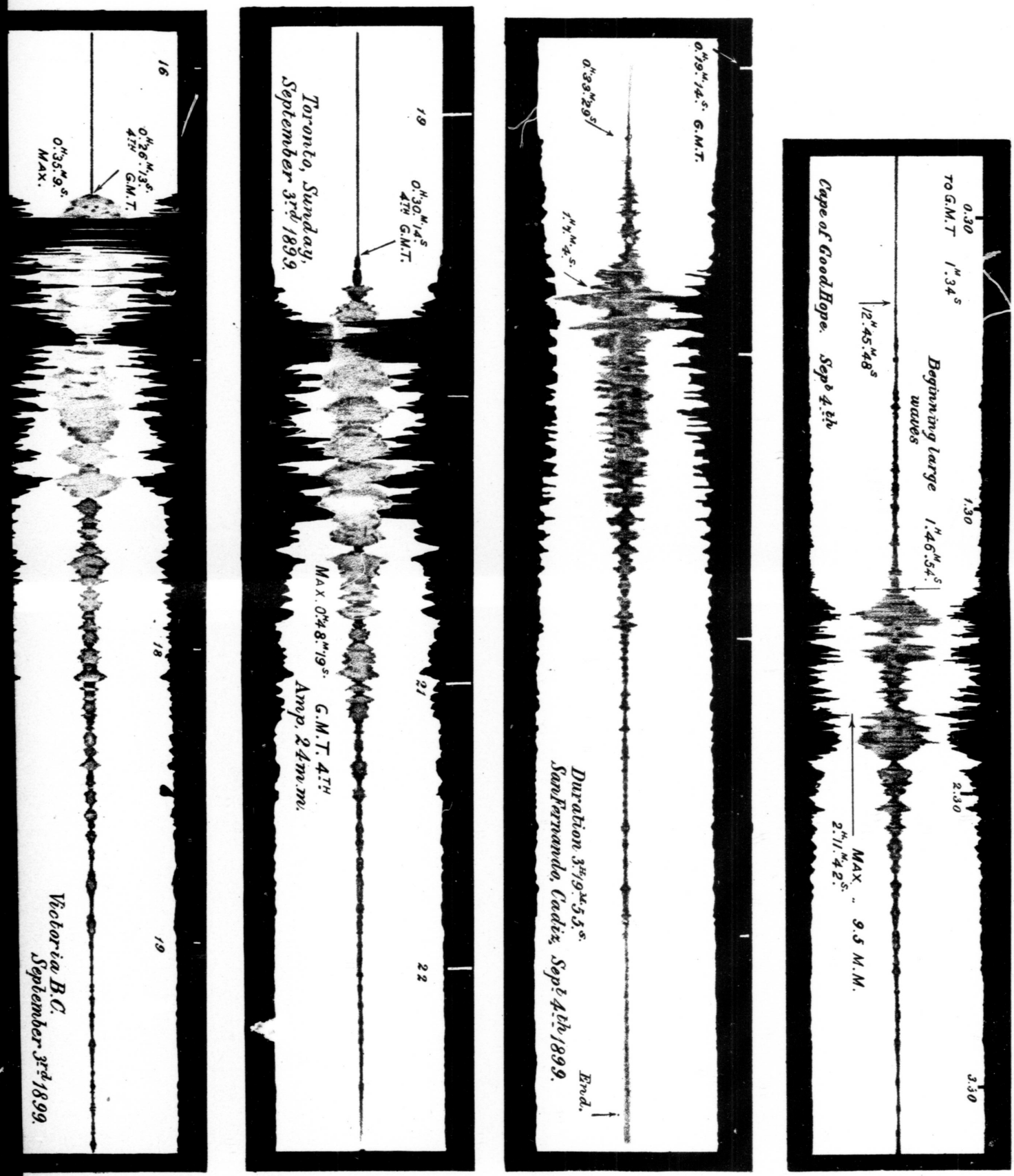
The table shows the latitude and longitude of the points and their distance by great circle and chord from Mount St. Elias, also the time expressed in Greenwich civil time at which the disturbance was recorded.

	Lat	Long.	Arc.	Chord.	G.M.T.
Victoria.....	48° 25′ 31″ N.	123° 21′ 33″ W	1039km.	1036km.	$0^{H}\ 26^{M}\ 13^{S}$
Toronto.....	43° 39′ 36″ N	79° 23′ 40″ W	2700km.	2648km.	0″ 30″ 14″
San Fernando	36° 27′ 42″ N	6° 12′ 20″ W	5256km.	4877km.	0″ 33″ 29″
Cape of Good Hope.....	33° 56′ 04″ S	18° 28′ 41″ E	10373km.	7641km.	0″ 46″ 12″

Value of Kilometer--6214 Miles.



Seismograms obtained in various parts of the world illustrating the effect of an earthquake which occurred, on September 3rd, Alaska, near Mount St. Elias, in latitude 60° N. and longitude 140° W.

The table shows the latitude and longitude of the points and their distance by great circle and chord from Mount St. Elias, also the time expressed in Greenwich civil time at which the disturbance was recorded.

	Lat	Long.	Arc.	Chord.	G.M.T.
Victoria	48° 25′ 31″ N.	123° 21′ 33″ W	1039km.	1036km.	0h 26m 13s
Toronto	43° 39′ 36″ N	79° 23′ 40″ W	2700km.	2648km.	0″ 30″ 14″
San Fernando	36° 27′ 42″ N	6° 12′ 20″ W	5256km.	4877km.	0″ 33″ 29″
Cape of Good Hope	33° 56′ 04″ S	18° 28′ 41″ E	10373km.	7341km.	0″ 46″ 12″

Value of Kilometer--6214 Miles.

Observatory in a seismological survey of the world, and recommending that a seismograph of the Gray-Milne pattern should be purchased and there installed. Sir Louis Davies, the minister under whom I have the honor to serve, was pleased to authorize the expenditure of the necessary funds, and our seismograph was put in operation on September 20th, 1897, at 4 p.m.; and, as it proved, it was exceedingly unfortunate it was not started a little earlier, as at the very moment we were engaged in making the final adjustments, the earth was pulsating from the effects of a violent quake which had occurred in Borneo. The instrument used consists of a horizontal pendulum with a boom two feet six inches long, at the end of which is a plate in which is a narrow slit, parallel to the length of the boom. The position of this beneath a slit at right angles to it is shown by a speck of light from a small lamp, reflecting downwards, which photographs continuously on a bromide film two inches wide, which passes at the rate of five feet each day. Every hour the light is eclipsed by a screen attached to the long hand of a watch, and thus a time scale is applied.

It may also be mentioned here, that when in Toronto at the meeting of the British Association, Prof. Milne informed me that the committee wished to have a station on the Pacific coast. As I knew that there was an association grant for starting some few stations, I informed him that, if the committee would supply the instrument, the Meteorological service would supply an observer; and the result was that in the summer of 1898 a seismograph was put in operation at Victoria, B. C., in charge of the meteorological observer, Mr. E. Baynes Reed.

The first earthquake recorded in a thoroughly satisfactory manner by the Toronto instrument occurred on December 29th, 1897. At 11h 22m 7s G. M. T. at Port Au Prince, Hayti, there were three violent shocks within 48 seconds. At Santiago numerous buildings were much injured. This quake had a sub-marine origin and interrupted two cables from the island. Ten minutes twenty three seconds after the first shock in Hayti our Toronto seismograph began its record, and 8m 19s later it was recorded in the Isle of Wight. I find from the British association report that the tremors were also recorded in Italy and Russia. As I would doubtless weary you were I to enumerate anything like

the full number of quakes we have recorded in Toronto and Victoria, I shall ask you to observe the seismograms for the 24th January, 1898. In response to a letter which I wrote to the Director of the Observatory in the City of Mexico, he wrote me that two shocks of earthquake were recorded in Mexico on January 24th, the first at 5.29 a.m., and the second at 5.9 p.m., the first being slight and the latter strong. The earthwaves caused by both of these quakes were recorded in Toronto and Victoria, B. C. I shall not show you the seismogram of the first as it was comparatively small, but will show you the second. Prof. Milne thinks that the time of the origin of the quake was two minutes earlier than in Mexico; if so, we have Greenwich time at origin 11h 43m 31s, beginning or preliminary tremors 6m 53s later in Toronto, and 7m 36s later in Victoria, or about a velocity of eight kilometers per second in both cases. The larger waves reached both Victoria and Toronto between 22m and 23m after the quake occurred, travelling at a rate of about 2.5 kilometers per second. This quake was also recorded at the Isle of Wight, Kew Observatory, in Russia, Italy, Trieste and Bombay; and all stations agree that the time of the arrival of the larger wave gives a velocity of about 2.5 kilometers per second measured on the arc. On 7th March the seismographs recorded a Japanese quake of much severity, the time of transit of the long waves was as follows: Isle of Wight 59m, Kew 59m, Rocca di Papa in Italy 56m, Toronto 65m, Trieste 47m.

A point of interest in these seismograms is that the tremors as recorded in England were greater than at Toronto, and at Toronto they were greater than at Victoria, the station nearest to the origin. This latter place would be reached by a path entirely beneath the Pacific, Toronto by a path crossing Behring Straits, and Shide (Isle of Wight), by a path across Asia to Europe. Such records suggest that oceans exert a damping effect upon the earth waves traversing their beds.

Many quakes followed during the next three months, but we will pass on to June 8th. There were two shocks recorded on this day, and there is strong reason for supposing that the origin was in the West Indies, east of Jamaica. The times were as follows:

		h	m	s		h	m	s
Prely. Tremors.	Toronto	4	42	27	Waves	4	54	16
	Victoria	4	48	10	"	5	9	0
		0	5	43		0	16	44
Prely. Tremors.	Toronto	15	7	54	Waves	15	16	0
	Victoria	15	13	1	"	15	30	47
		0	5	7		14	47	0

Also the magnets at the Agincourt Observatory near Toronto began to swing at 15h 16m.

Passing on to July 14th, an important disturbance began at Victoria at 13h 41m 0s, and at Toronto 1h 27m later. The large waves reached Victoria in 8h 3m and Toronto in 19 26. The origin of this was clearly near the Sandwich Islands, where heavy quakes occurred on this day. and Mauna Loa was in violent eruption ; this disturbance was also recorded by the magnets at Agincourt.

Tremors announcing another quake began in Victoria at oh 26m 13s G. M. T. on the 3rd, September, and 4 minutes later at Toronto; and the large waves reached the former point at oh 30m 14s, and the latter at oh 48m 19s, about which time the magnets began to swing. This was the great Alaskan quake of September 3rd. The preliminary movement was registered at Kew Observatory, England, 6m 52s after Victoria, and at Cadiz, Spain, 25 seconds later. Another shock followed something over four hours later and this likewise was recorded by the seismographs in all parts of the world.

On the 10th, in the same region, two other world shaking quakes occurred. Unfortunately the Victoria seismogram was lost in the mails, but, as the slide now on the screen shows, Toronto recorded both of them and most satisfactory records were obtained throughout Europe, and presumably Asia and Africa. As at the Cape of Good Hope, the disturbance was very pronounced. I regret that so far I have been unable to discover the exact centre of these quakes ; but, from such accounts as have been received, it would appear that they were the most severe ever experienced In those regions since visited by white men.

The only other seismograms I will show you are those of a severe quake which occurred in Mexico on January 20th of this year; the preliminary tremors reached Victoria at 6h 39m 48s and Toronto 29 seconds later, while the larger waves reached Victoria at 6h 53m 38s and Toronto 2m 19s later. These figures indicate a somewhat different origin from the quake of the previous year on the 24th January; and it is probable that the centre was near Colima near the west coast of Mexico.

I have shown you a number of seismograms and read you a lot of figures; but what may we learn from them? In the first place we see that, in nearly every instance, disturbance is first indicated by a feeble movement of the pendulum, lasting during an interval of from a minute to a quarter of an hour, to be followed by a movement of much greater amplitude, which in most instances began suddenly. It is fairly evident then that, in earthquake motion, certain preliminary tremors of small amplitude outrace the larger movements, and analysis of these seismograms seems to indicate that it is quite probable that these tremors may be propagated through a very rigid interior of the earth, radiating from the origin in all directions; while the larger waves are surface waves in the crust of the earth.

Rules which are likely to prove appoximately correct are:

1. The velocity in kilometers per second with which these preliminary movements are propagated is equal to one quarter of the square root of the mean depth in kilometers of the chord or path along which we may suppose they travelled.

2. The duration of preliminary tremors, or the interval of time expressed in minutes by which they outrace the longer period waves as shown by the seismogram, equals the square root of the mean depth of the supposed wave path expressed in kilometers.

A very natural question is—"Your seismograph records the passage of these earth waves, the magnets at your observatory begin to swing—how is it then that we do not feel them?" We do not feel these waves because they are very long and slow undulations, and each pulsation may be from 50 to 60 kilometers in length.

My own study of seismograms has led me to the conclusion that there are many changes to be made before we can expect

thoroughly satisfactory results. A great advance has been made in getting instruments of the same pattern in various parts of the world; but so far sufficient care has not been taken to have them adjusted alike, and hence the pendulums respond to vibrations of different periods ; then it appears to me that the times of the cut off of light are not reliable, and this of course is a source of confusion. Matters, however, are improving in both respects, and before long we shall have observations which are strictly comparable, and results are likely to be more accordant.

Professor Milne and several other observers have found a diurnal wave in the records of seismograms—i. e. a slow tilting which takes place in piers and buildings, especially on fine days, for six or ten hours rapidly in one direction, and during the remainder of the twenty four hours, more slowly and in an opposite direction. This movement may be found underground where changes in temperature are insignificant. The actual cause of these movements is at present matter for speculation ; but the theory which best explains the phenomena they present, as for example that, on the opposite sides of a valley, it has been observed that movements take place simultaneously, but in an opposite direction, is that these changes in the vertical are due to differential changes on opposite sides of a station in the loads removed during the day, or acquired during the night, by evaporation and condensation of aqueous vapours. During the day it is assumed that, by ordinary evaporation and the transpiration of plants, the bottom of a valley loses more weight than its comparatively drier and less clothed sides.

During a hot day the stream at the bottom of such a valley should discharge fewer and fewer gallons of water, whilst the valley bed, because it is relieved of load, should rise. For the remaining fourteen or eighteen hours, because aqueous vapour is condensed beneath the chilled surface of the ground, or as it emerges from the ground on plant and other surfaces, the stream in the bottom of the valley would increase its flow; and relatively to the sides and bounding ridges of the valley, where we may suppose the conditions for condensation to be less favourable, the lower parts of the same would become heavier and consequently sink. As to whether this concertina-like opening and shutting of valleys, representing changes of slope of one or two inches in three

or four miles in the average inclination of their boundaries, really exists, all we can say is that instruments have given indications that it can be explained on such a supposition. The fact that the piers carrying some of the instruments have risen from the chalk, and not from the alluvium, and that during long continued wet weather there is a continuous creeping of a horizontal pendulum the heavily loaded valley bottom, and the direction of greatest movement at the time of an earthquake appears to be at right angles to the dip, from which it may be inferred that valleys due to geotectonic folding exhibit a certain flexibility, tend to support the idea that the observed diurnal movements are due to actual movements of more or less extensive areas. No doubt some portion of the observed effects may be directly attributable to solar radiation. In Toronto and Victoria we have not recorded such movements, and I think it is that our instruments are placed on piers built very substantially and very deep.

TOTAL NUMBER OF QUAKES RECORDED AT TORONTO AND VICTORIA, B. C.

	VICTORIA	TORONTO
1897	From Sept. 20	12
	From Oct. 11.	
1898	9	30
1899	111	135
1900	25 to Feb. 13th.	19
	155	196

Table Showing Length of Chords in Miles and Kilometers.

Assumed	Lat.	Long.	Victoria		Toronto		Shide, Isle of Wight	
Radius: 6360 Kilometers 3951.9 miles			Lat.	Long.	Lat.	Long.	Lat.	Long.
			48° 24'	123° 19	43° 40'	79° 24'	50° 42'	1° 18'W
Hawaii	21° 18'	157°55'w	Miles 2899	Km. 4650	Miles 5048	Km. 8124	Miles 7307	Km. 11759
Mexico	19 26	99 7	2512	4043	2103	3385	5905	9503
Port au Prince	18 35	72 18	3716	5980	1777	2861	4757	7655

WELL WATERS: A STUDY

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When rain falls to the earth it is either absorbed by soakage, or it flows along the surface to lower levels. Usually both flow and absorption take place, but the ratio between the quantity carried off by surface flow, and that absorbed, varies with the nature of the soil, the degree of slope, and other conditions.

When the surface is nearly level, and porous, as is the case with ordinary arable land, most of the water will disappear by soakage, and if the rainfall is heavy, the ground will be wetted to a great depth.

In the diagram (Fig. 1) the dotted portion represents a layer of porous soil, S—(which may be sand, loam, gravel, etc.), underneath which lies a non-porous layer, C (clay), represented

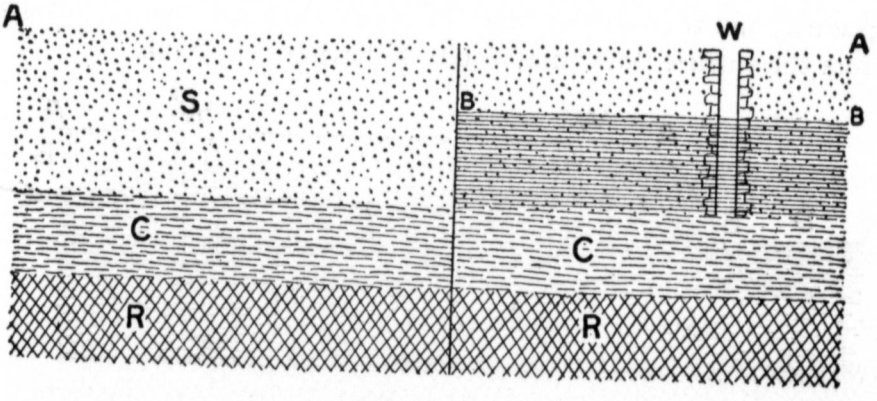


Fig. 1.

by short lines, and underneath this again is a layer of rock—R. The rain which falls on the surface A, will gradually sink through the porous soil till it reaches the impermeable clay ; and shortly after the rain ceases, we may have the state of things represented at the right hand side of the diagram, which shows the porous soil thoroughly soaked from the surface of the clay up

to the level B. This last is the so-called *ground-water level*; and it is evident that the depth of the ground-water level, below the surface level, will vary with the rainfall, and with the thickness of the stratum S: will be highest after heavy rain, and lowest after prolonged drought.

For every region an average may be struck, which is known as the mean annual ground-water level, and we may suppose B to represent this mean level for the area under consideration. If now, a well be sunk, as at W, to the clay, this well will contain water to the depth of the average ground water of the locality. If the well be carried lower, *i.e.*, into the clay, the result will not be to change the character of the water, but merely to enlarge the storage capacity of the well. Extensive areas of level land, as in prairie regions, beaver meadows, etc., answer to the conditions described; but certain other characteristics of ground-water must be considered.

Ground-water is never stagnant, but is moving more or less rapidly towards some line of lower level, where a brook, or river, or lake will generally be found. In Fig. 2, D represents a section of a stream, whose waters will evidently rise and fall with the level of the ground water, which supplies them; and we must discriminate between this rise and fall, which is always gradual, and that sudden rise, of short duration, which results from the surface flow immediately following heavy rain.

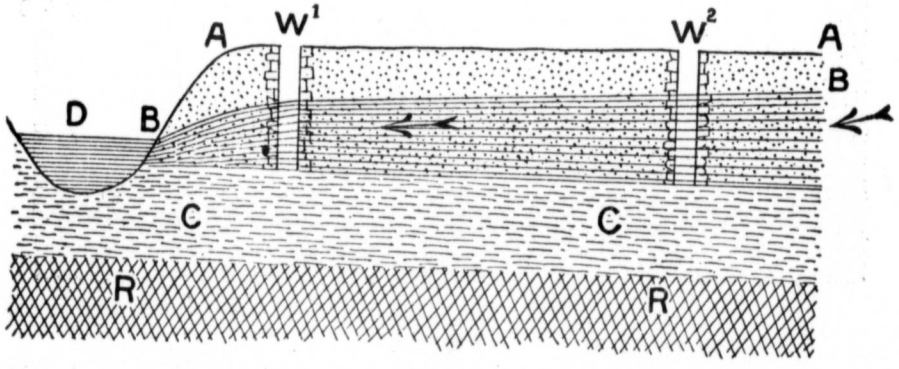


Fig. 2.

The flow of the ground-water will be in the direction indicated by the arrows, *i.e.*, at right angles to the course of the stream, and the line B B, will be a gradually sloping one, so that the well W^1 will contain less water than W^2 at the same

time, although the wells may be of the same depth, and penetrate identical strata of sand, gravel, etc.

It must not, however, be supposed that stratification of so simple a type as I have described, is at all common. Soil, by which I mean everything that is not rock, has resulted essentially from the operation of chemical and mechanical forces upon solid rock. The chief of these forces have been, (1) the freezing of water in the pores of the rock, thus breaking it up; (2) the action of rain; (3) the alternate expansion and contraction by heat and cold; (4) attrition of stone upon stone at the bottom of rivers and lakes; (5) the movement of large ice masses (glaciers); (6) solution of certain rock components, with the consequent falling apart of the residue; (7) action of the roots of plants, which action is both mechanical and chemical; (8) chemical action by oxidation, formation of carbonates, etc. Many of these changes have taken place under water, and every part of the earth's surface has again and again been the bottom of lake or sea, so that soil formed by the means described, does not necessarily remain on the spot which produced it, but may lie hundreds of miles away. Thus, soils which have resulted from the attrition of rock masses in the regions round about Algoma, now cover the fields of Southern and Eastern Ontario. This sort of thing has happened the world over; and the carriers of these immense masses of clay, sand, gravel and boulders, have been ocean and river currents; but above all glaciers and icebergs.

An iceberg is not a large block of clean, pure ice, but a section of a glacier, broken off by the lifting power of the ocean when the moving mass has been so far thrust into its waters that their buoyancy overcame the strength of the ice, and a huge mass snapped off, rose to the surface, and was carried out to sea. This ice mountain contains, frozen into it, perhaps thousands of tons of rock detritus. It floats out to sea, and wherever it melts, this soil-forming material is deposited, perhaps forming a heap or hill, perhaps being strewed along the course of the floating bergs. After a period of submergence, which may be hundreds of thousands of years in duration, subterranean forces cause, what was so long sea bottom, to become dry land; and we can imagine the condition of things described

without too much difficulty, since a little observation of regions quite accessible to us, shows us very marked traces of the period itself. Of course the influence of new forces comes into play on what is now dry land. Atmospheric effects, vegetable and animal life, sunshine and storm play their part in altering the surface ; and in the end this comes to be just what we find it, the very ground upon which we build our houses and in which we dig onr wells.

In Fig. 3 we have a somewhat more complex section diagrammed, representing a state of things much more usual than the very simple conditions described in Figs. 1 and 2.

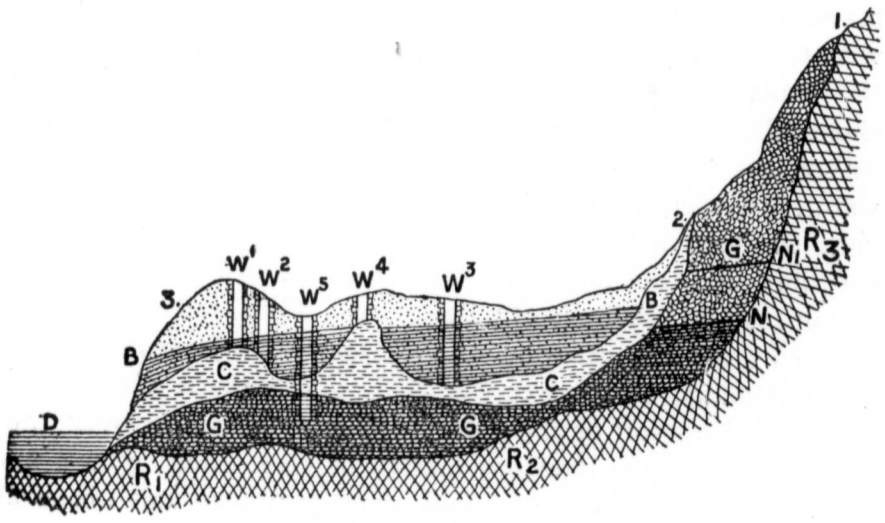


Fig. 3.

Here we have the rocky substratum R, more or less contorted throughout, and upheaved as a mountainous ridge at R^3. Conformable to the surface of the rock, but of varying thickness, we have a stratum of gravel, G, which crops out on the surface between 1 and 2. Lying on this gravel is a layer of clay, C, which varies in thickness, and comes to the surface at 2. Overlying this, is the soil,S. The line B^1B^2, represents, as before, the mean level of ground water, with a gentle slope towards the drainage stream D. The rain, which falls on the region 2 to 3, supplies this ground water, which is tapped by the wells, W^1, W^2, W_3. It is at once evident why a well at W^4 remains dry, or only contains water when the season is abnormally wet. The rainfall on the rocky surface to the right

of 1, is of course not absorbed to any great extent, but flows down to the gravelly surface between 1 and 2, and together with the rain falling on this surface, is absorbed by the gravel, and finds storage in it between the rock (R) and the clay (C). Here it accumulates in a second and lower water-bearing stratum, and the normal level for this water supply may be represented by the line N. Now it is evident that if any of the wells W^1 to W^4 be continued through the clay, they will obtain a water supply from this lower gravel; and the well W^4 can get a permanent supply from no other source. W^4 then becomes an illustration of a so-called 'deep well,' and in wet seasons, when the level rises above the normal N, say as high as N^1, this well will overflow, or become what is called a 'flowing well,' on the principle that water rises to the same height in all tubes connected with a common reservoir.

If I have succeeded in making my subject understood, we are now prepared to begin the special enquiry that I wish to propose for your consideration. Up to this point, I have merely defined and illustrated certain terms that I shall have to use repeatedly in the sequel. To recapitulate briefly, I have spoken of three classes of wells, viz. : those fed from the normal ground-water, those fed from a deep or secondary water supply, and those so-called surface wells, which, like W^4 in Fig. 3, receive soakage water only, and contain a supply only when the ground in the immediate vicinity is wet, as in Spring and Autumn. All the ground-water wells diagrammed, are represented as dug down to the subjacent clay; but this is not a necessary condition. W^3 for example, would be none the less a ground-water well, had it been made no deeper than W^1 and W^2. We have now to consider the character of the water which fills these three types of wells.

Rain water is not the chemically pure substance which it is often described as being. In the later stages of a prolonged rainfall, it is indeed very nearly pure, but the first portions of every shower wash out from the air, not only the gaseous impurities, which are the products of animal and vegetable decay —(Ammonia, compound or organic ammonias, sulphuretted hydrogen, etc.)—but also those solid particles, rich in microbial life, which form the dust of the air, and are partly organic and partly inorganic in character. This rainwater, falling upon the

surface of the ground, flows along this surface, or soaks into it, taking momentarily into solution more and more of the soluble matters with which it comes into contact. These are partly inorganic salts, chlorides, sulphates, carbonates, silicates, etc.—and partly organic matters of more or less complex nature, the products of the decay of vegetable and animal matter. If, for example, in Fig. 3, the region 2 to 3 is a cultivated farming country, somewhat sparsely inhabited, the organic impurities will chiefly be of a vegetable kind—rotting vegetation, the manure of the fields, etc. ; but if it be a village or town, the organic matters will be more largely of animal, and especially of human origin. To these waste products the term sewage is properly applied. The ground-water of this region may be, therefore, much less pure than was the rain water that fell on the surface or gathering-ground. I say *may be*, for reasons which will be presently given.

We may dismiss the *inorganic* impurities with a word, by saying that, unless they are present so largely as to give a distinct taste to the ground-water, they are rarely of a kind to be dangerous to health. The *organic* matters must be more carefully considered. If they have originated in normal decay, they may be harmless from the point of view of health, even though far from appetizing when we remember their origin ; but if they come from those conditions of decay which we call *disease*, they may be actively poisonous, and may contain the living germs of specific diseases, such as fevers, diphtheria, cholera, etc.

Percolation, though a fully ærated soil, has, however, the effect of bringing about purification of such water by the process of oxidation, a process by which organic matter is changed and microbial life destroyed. That this should be effective, the water must filter through several feet of sand or gravel ; and although it is impossible to fix a definite minimum limit to the depth of such a natural filter, it is safe to say that we should insist on ten feet, at least, and prefer as much more as we can get. To this end it is necessary that the upper ten feet of the wall of a well should be made quite impervious to water, and the accompanying diagram shows how such a construction can be brought about.

A well should be so constructed that no water could find entrance to it without filtration through a depth of soil, at least

equal to the vertical distance between the ground level, and the lowest level of ground water. To insure this it is necessary to have the mouth of the well raised a foot or more above the surface of the surrounding soil, and to have the brick (or stone) lining of the well backed up by a layer of puddled clay, a foot or more in thickness, and extending continuously from the level of the ground water quite up to the mouth of the well.

DIAGRAM of well; showing a backing of puddled clay, or other impermeable material between the brickwork and the porous strata through which the well is dug.

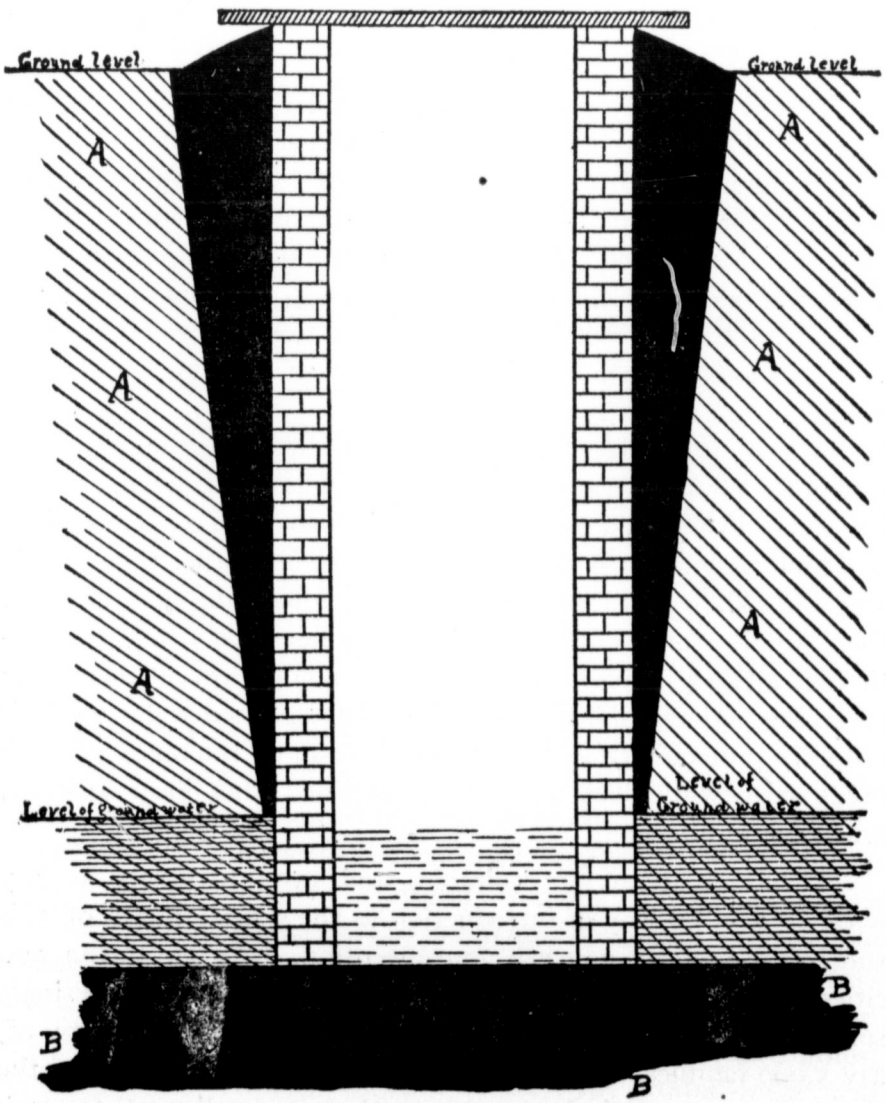


FIG. 4.

A—porous strata, such as sand, gravel, loam, shale, etc. B—impervious stratum, such as clay, rock without flaws, etc.

The accompanying diagram will serve to explain what is meant. By this construction surface water is prevented, by the impermeable clay backing, from getting entrance to the well until it has percolated through the earth to the line of level of the ground-water.

It will be quite clear that no one of the wells in Fig. 3 can be free from unfiltered, and consequently dangerous water, unless this precaution is taken, since even those which reach the ground-water may be polluted by the soakage of unfiltered surface water.

If now we study the gathering ground 1 to 2 in Fig. 3, we have a wild, rocky, and probably unsettled tract of land, free from animal impurity, and comparatively free from vegetable decay. Moreover, its distance from the point, at which the water collected on it is used (W^5), ensures thorough filtration, and we can see at once why the water of this deep stratum should be eminently pure and wholesome. Such water is, for obvious reasons, apt to contain more mineral matter in solution, and may even conform to the type of a true mineral water. Unless this be the case, it is evidently a very desirable domestic supply, and wells like W^5 are always to be preferred when attainable. Even these, however, must be protected against soakage contamination, to which they are just as liable as those of any other type. This study has shown us that shallow wells, obtaining as they do, their supply from unfiltered soakage can never be safe for domestic use, although favorable circumstances may prevent them from becoming actively disease-producing; that ground-water wells, if properly protected from local contamination by soakage, are generally safe; while deep water wells, guarded from local soakage, are safest of all.

It has seemed to me desirable, and even necessary to say what I have, by way of introduction to the special phase of this subject, to which I now ask your attention. Large towns and cities, as a rule, obtain their water supplies from some single source, a river, lake or spring, so that each family in a city of, say 5,000 families, is supplied with water of the same kind as the rest. It consequently becomes a matter of small cost to each family, to take care of this common source of supply, to have it examined from time to time, chemically and otherwise. Moreover, their is generally a Board of Water Commissioners ap-

pointed to look after the matter, and an engineer, whose special duty it is to see to the protection of the supply, and its proper distribution. Compare this with the case of 5,000 families resident in the country. It is probable that these obtain their water supply from 5,000 different wells, each having its own peculiarities of situation and protection, and each well having a special interest, only to the particular family drawing water from it. If the owner of one of these wells desires to have it examined with a view to determining its purity, the total cost of such examination falls upon himself, and any opinion procured by him, has no value for his neighbors, and does not help them to a conclusion as to the safety or otherwise of their wells; yet it should be a matter of great importance to each of them to know that, not only his own, but his neighbor's well is pure. If one well become polluted with typhoid germs, for example, this disease may spread over the whole neighborhood, as has happened again and again. If a school well, or the well of a resident near a school or church, and likely, on that account to be visited by many people, becomes infected with typhoid, or diphtheria, or cholera, or other germs, it may become a prolific source of the disease. I have often asked myself this question: "Can no way be devised whereby useful information, regarding the safety of country wells can be obtained, which will be comparatively inexpensive, and therefore practicable?" No answer is forthcoming that fully satisfies all requirements; but I believe that the suggestion I am about to make, goes some way towards solving the difficulty and is, at least, worth serious attention.

In the first place, we may conclude that normal ground-water is a safe source of supply. Owing, however, to the fact, that the soil and sub-soil of one locality differs from that of another locality in nature of constituent materials, their depth, compactness or porosity; contiguity to neighboring heights, of land, or to swamp; as well as in amount of annual rainfall, we cannot expect ground-water to have the same characters everywhere. What we may expect is that in a given geological and topographical area (perhaps extending over many square miles, perhaps less than one square mile in size), the ground-water will have a certain definite character. If the soil consist largely of limestone *debris*, we shall find bi-carbonate of lime in the water, if gypsum characterize the soil of the locality, we shall find sulphate of lime in the water, if chlorides be present in the soil, then

chlorides will be found in the water, and so on. In a neighboring area, separated, say, by a ridge of granite from the first, and having a soil resulting chiefly from the weathering and disintegration of granite, we shall find a ground-water much softer than the first, and having small quantities of silicates, and other products of the disintegration of granite in solution. Now all the wells, and there may be hundreds of them, which are dug into this ground-water, will fall into a class by themselves, and exhibit common characters, provided that local soakage is prevented and the water they contain be the uncontaminated ground-water of that region. How then will an individual well be affected, in whose case sewage finds entrance? Organic matter will increase, and especially will this be true of nitrogenous organic matter; phosphates and chlorides will be increased, nitrates and nitrites may be found in it, and a bacteriological examination may reveal the presence of new forms of microbial life. To determine all this, a full analysis is of course needed. What I propose to do, is to confine attention to some one characteristic, and to select that one which is most surely altered by the entrance of sewage, and is at the same time most easily and certainly determined. This I find to be the *Chlorine in Chlorides.*

The determination of chlorine, in chlorides, is one of the simplest and most definite estimations that a chemist can be called upon to make. Owing to the presence of common salt (chloride of sodium) in human food, and its use by domestic animals, it is always found in sewage, so that any notable admixture of sewage with a well water, at once raises the chlorine precentage.

Chlorine is, however, invariably present in normal ground-water, and the question arises for each region; "How much chlorine is normally present in the ground-water of this locality?" Of course the answer can only be given after analysis of normal samples, but once it is known, any marked variation from that standard, stamps a well of that region as suspicious, and justifies discontinuance of its use until fuller examination can be made. It must not, however, be forgotten that contiguous wells, like W^2 and W^5 in Fig. 3, may obtain their water from entirely different sources, so that it becomes necessary to take depth, and other factors into consideration. For the lower or second water bearing stratum may have a very different normal content of chlorine from the first or ground-water proper; but its number

will also be a fixed one, and if once known, it will be as easy to detect any sewage contamination in this kind of well as in the other.

It is also to be noted that the normal chlorine number for a given area, will vary from month to month, and will be especially affected by unusually heavy rainfall, or by prolonged drought. But experience shows that variations, due to these causes, are insignificant in comparison with those resulting from sewage contamination.

For some years past I have endeavored to put this method to the test of experiment, and for that purpose I have collected personally and by deputy, over 730 samples of well water, chiefly within the drainage area of the Ottawa valley. The difficulties which lie in the way of any single individual's accomplishment of so gigantic a task as this, are almost insurmountable ; and I can only hope to illustrate the subject in a very imperfect way from the data in my possession. The first difficulty is to obtain samples which truly represent the normal ground-water, and the normal deep water supply or supplies. Very few country wells are protected against surface soakage by the method indicated in Fig. 4, and I may say here, that I think the Provincial governments might profitably entrust to certain of their officials whose work takes them to different parts of the country, as in the case of the Road Inspectors, the Board of Health officers, etc., the additional duty of seeing that new wells are properly protected from surface drainage. It costs very little more to properly protect the well by tamping clay behind the stones when the well is being made, than to finish it in the unscientific way in which we find this important matter usually performed, and I am sure that it is ignorance rather than any wish to save a few dollars at the risk of health, which explains the unsatisfactory condition of nearly all the wells which I have visited.

If, in each topographical area, we could find a few thoroughly protected wells, of known depths, and of whose history a full record had been kept, we should possess the data which we require, and which we cannot now obtain with any such certainty as would give a sure basis for the illustration of the scheme I have suggested.

It is by so much the more important that new wells should be constructed in such a way as to fulfil these conditions.

On the 13th October, of last year, I personally visited 43 wells, chiefly on farms, in the district between Kinburn and Packenham, in the County of Lanark. This is an extensive clay region, fairly level, except quite near Packenham, where the land dips towards the Mississippi river. The Mississippi rises in a series of small lakes, about 80 miles west of Packenham, in the townships of Abingdon, Barrie and Clarendon, in Addington County. These townships are very thinly settled, and the whole course of the river is through a region but little affected by human habitation. With the exception of the towns of Perth and Almonte, it may be said to be quite as nature left it, and a purer gathering ground could not be wished. This is proved by the fact that a sample of the river water taken at Packenham gave only two parts of chlorine per million. No doubt, this small content of chlorine is chiefly derived from sewage for, although the organic matter of sewage may change by oxidation as already explained, the chlorine remains, to tell the tale of past sewage pollution. In the case before us, the amount is too small to give any concern for the purity of the river water—No doubt there are points on the river, (e. g. just below the town of Perth,) where locally, a higher chlorine figure would be found, pointing to local and serious sewage contamination. But the volume of the river is so large, that by the time the sewage has distributed itself uniformly throughout it, the figure 2 per million, for chlorine, has been reached, and the organic impurities have been fully oxidized.

The following numbers were obtained for seven wells in the region referred to ; the wells having a depth of less than 10 feet, and being of the kind called surface wells.

WELL	DEPTH	CHLORINE PER MILLION
1	9 ft.	4
2	9 "	10
3	9 "	22
4	10 "	22
5	8 "	26
6	7 "	32
7	8 "	180

Why are these numbers so much higher than the river water gave ? There is but one answer :—the wells are dug in soil which is more or less saturated with sewage. Not one of these wells, so far as I could learn, was protected by a clay backing, (see Fig.

4) from soakage, and consequently, most of them are contaminated with sewage which has undergone no such amelioration by soil-filtration as would have resulted from proper construction. Not one of them is certainly a safe well ; while No. 7 cannot but be a most dangerous supply.

In the following table I have placed the resulting numbers from examination of 21 wells—varying from 10 to 20 feet in depth : These samples were taken on the same day, and from the same region :

WELL	DEPTH	CHLORINE
1	20	4
2	12	4
3	16	4
4	18	6
5	18	14
6	15	16
7	12	22
8	15	24
9	13	32
10	14	32
11	12	44
12	17	48
13	20	54
14	17	88
15	12	90
16	13	92
17	13	98
18	12	114
19	18	128
20	18	194
21	12	370

It is quite likely that most of these wells derive the main portion of their supply from the ground water of the locality ! but it is very certain that most of them are contaminated with soakage water. The first four are among the deepest of these wells, and as likely to be true ground water wells as any ; yet their chlorine content is not high—in fact, the very highest chlorine numbers in this list correspond to decidedly shallow wells, whose contamination by sewage is beyond a doubt.

The following six wells, are decidedly *deep wells*, and should give pure water, were they properly protected from soakage.

This they are not, however, and I cannot feel sure that the chlorine they contain is not, at least in part, due to sewage.

DEEP WELL	DEPTH	CHLORINE
1	25	24
2	35	56
3	46	58 (in rock)
4	25	170
5	25	195
6	25	240

Two wells in this region answer to the type of mineral springs. They contain respectively 3775 and 3700 parts of chlorine per million. It is quite evident that this chlorine has a mineral, and not a sewage, origin, and I mention them to show how marked a distinction exists between such wells, and the ordinary domestic well.

Later in October, I collected, partly in person, and partly by deputy, seventy samples of well-waters along the Montreal road, through the villages of St. Joseph, Blackburn and Cyrville, and the adjacent country. Of the wells less than 10 feet deep, eight contained less than eight parts chlorine per million and 13 others gave chlorine varying from 16 to 250 parts, six wells yielding more than 100 parts per million. Most of these wells were so evidently unprotected that I was prepared to find them dangerously contaminated, as the result shewed them to be.

Of 31 wells having a depth between 10 and 20 feet, only two gave less than 10 parts of chlorine ; 14 gave more than 100 parts, and 5 more than 200. There can be no doubt whatever that most of this chlorine has a sewage origin.

Of the deep wells, the following is the record :

DEEP WELLS	DEPTH	CHLORINE
1	?	2
2	21	6
3	26	26
4	30	52
5	96	52
6	22	86
7	?	110
8	27	280
9	23	670
10	155	860

It is noteworthy that the increase in chlorine corresponds to an increase in depth, if we omit numbers 6, 8 and 9 in this list. No. 6 is in a hotel yard, and the well is not properly protected—No. 8 is 25 years old, has no pump, and shows every sign of neglect in its surroundings, and No. 9 is 18 years old, not protected from soakage, and dug in soil which has been used as a garden and otherwise from immemorable time.

I have made, at different times, similar collections of well-water samples near Peterboro, near Hamilton, and at several places nearer Ottawa. The analytical data have a special interest for the neighborhood in question ; but for such a general study as we are now making, it seems scarcely worth while to quote them. They emphasize the point to which I have already drawn your attention, viz.—the difficulty of ascertaining the true chlorine value of normal ground-water. If any considerable number of properly protected wells existed in a given locality, there would be no difficulty about this matter, or at least, the difficulty would be much lessened. A moment's thought will shew you why I speak so guardedly. The chlorine of sewage persists, even after the dangerous character of the sewage has disappeared ; so that a properly protected well, dug in a soil which is saturated with sewage, may contain water which is safe in domestic use, for, although it contain the chlorine which the sewage contained, the truly dangerous organic matter of the sewage has been destroyed by soil filtration, and is now harmless. The chlorine now points to "past sewage pollution." I think that most of us would prefer that the sewage pollution of the water we drink should be a long time past. I am only mentioning this feature of protected wells here for the purpose of pointing out that the chlorine number of such a well may be much higher than that of the normal ground-water of the locality, and that it would be unsafe to deduce the normal number from it. It is quite true that two wells may be dug side b side, and 'heir water give the same chlorine number, yet one of them may be safe and the other unsafe in use. This only shews that a final decision must not be reached from the consideration of any single feature ; but that the history of the well should be studied as fully as possible. Every farmer who digs his own well must be in possession of the needed facts ; and the person who uses a well, with whose history and character he is unacquainted, is as foolish as he would be who should pick up a

bottle having no label, and drink its contents, in full reliance upon the watchful care of an over-ruling Providence.

Finally, I think that the care of wells should devolve upon their owners; but I believe that individual owners would find it economical and satisfactory to place this trust in the hands of specially appointed Township or County Officers ; and I consider it to be the duty of Provincial Governments to take the initiative in bringing to the notice of the public generally, the immense importance of this much-neglected subject—the care of wells.

LOCAL DEFLECTION OF THE PLUMB LINE.

OTTO J. KLOTZ.

In the present short paper it is only intended to lay before the Society certain data of the deflection of the plumb line as found by latitude observations and azimuth surveys along the International Boundary, 49th parallel, from the Lake of the Woods to the Pacific Ocean. Those westward, as far as the Rocky Mountains, were published years ago in the United States Report of the Northern Boundary Survey, but those of British Columbia have, to my knowledge, never been published. The effect of deflection of the plumb line on longitude and azimuth observations is not considered in the present paper.

Deflection of the plumb line may be defined as the deviation of the vertical at any point from the normal at that point to the surface of an assumed figure of the earth. In dealing with the earth, we must assume its shape to be of some definite geometrical form and of certain dimensions, for only then can observations, at different points thereon, be correlated and adjusted. The best assumed form (Clarke's 1880 spheroid at present), however, differs at places widely from the actual form or geoid. To illustrate, if the continents were traversed by narrow canals, communicating with the ocean, their surface, although level, would be wavy or undulating, and would be in some places above, in other places below the surface of the spheroid or ellipsoid of revolution, the divergence of the two surfaces being probably confined to a few hundred feet.

The position assumed by the plumb line, is due to the law of gravitation, that is, it is the integrated result of the attraction of the individual particles, composing the mass of the earth, and hence the position is affected by the relative distribution of them. We may, therefore, say that the unsymmetrical distribution of the particles, whether on the surface, as mountains, etc., or in the thin crust, is the cause of the deflection of the plumb line

from its theoretical position. The ablest mathematicians have been engaged, ever since the era of precise measurement, upon this difficult question of the form and dimensions of the sea level surface.

In some instances we are quite prepared to find local deflections of the plumb line, for example, when observations are taken on the plains at a point near a more or less isolated upheaval, as the Three Buttes or Sweet Grass Hills in Montana, just south of the International Boundary. These hills, as we shall see later, pulled the 49th parallel out of its theoretical position about 800 feet. On the other hand, large deflections show themselves without any visible reason or cause as evolves from numerous observations and their geodetic connection. A remarkable instance is that of the comparatively plain area surrounding Moscow, which I visited recently, where, on the margins of an 18 mile east and west zone, large deflections of opposite signs were found. From this it must be concluded that there exists beneath the surface a cavity or at least matter of small density.

It is evident, therefore, that the observations alone, at any particular point, are not conclusive for fixing its geographical position upon the surface of the earth, but that numerous astronomically determined points must be connected linearly by triangulation, and from their inter-accordance, or discordance, the most probable values determined, based upon an assumed figure of the earth.

In our own city here, there appears, due to the topographical configuration, to be a deflection of the plumb line; for, the latitude determinations made by me at the observatory on the summit of the escarpment, compared with those made some years ago by Mr. Lindsay Russell on the opposite side of the river, show a discrepancy of about a second of arc, equal to about a hundred feet, a quantity greater than the error of observation. However, a more or less extended hypsometric survey would be necessary for a plausible *a priori* conclusion with reference to the probable discordance in latitude to be expected between two stations.

All observations for the determinations of positions upon the earth depend upon the direction of the vertical. Latitude and

longitude observations, the surveyors' and engineers' operations, all have their zero of reckoning in the centre of the level bubble, and any displacement of the latter, which is equivalent to the displacement of the plumb line, affects the results, and will show discordances when widely separated observations are geodetically connected.

It may be stated that a delicate level used for latitude work, reading to a second of arc, has usually a radius of about 1,700 feet, or nearly a third of a mile, for the curve ground on its inner upper surface.

To digress for a moment.

Boundary lines may be divided into three classes:—those representing a social unity, those representing a physical unity, and those representing a political unity. Those of the first find the largest number of representatives in the older settled countries, for the primal concept of boundary was to conserve the social unity. It was not to define territorial extent as much as to define or assert the domain of a like people; like by language, race, or religion or other affiliation. Such boundaries are, as a rule, very irregular and difficult to describe. When the social organism reached that development that written treaties became necessary between adjoining peoples, the description of the separating boundary was made from the boundary *de facto*, and the boundary not laid down from the description.

The second class we may consider an expansion of the first, resulting from conquest, whereby a physical as well as a social unity was to be preserved. Of the physical boundaries,—mountains, rivers and lakes,—to serve the purpose of barriers, by mountains, that end is undoubtedly best attained. Europe furnishes a number of examples of this.

The third class, which we may call the astronomic boundary, is a development of recent times, and applies invariably to areas practically unsettled, unsurveyed and little known. Such can be laid down on paper, or described in treaties without scarcely any knowledge of the country whatsoever.

While Europe furnishes the most examples of the first, America does so of the last. Many of the State boundaries of the United States are astronomic lines, either meridians, parallels,

or lines of definite azimuth. Similarly with the subdivision of Australia and recent boundaries in Africa. Astronomic boundaries may generally be taken as an index of the ignorance existing of the country or area involved and its resources.

Boundaries under the first division are difficult for definition or restoration when such is necessary. Those of the second, always dependent upon water, are generally self evident, while those of the third are comparatively easy of determination.

There are instances of a fourth class of boundaries—where the position of it is dependent upon the position of a physical feature,—e. g. that it be at or within a given distance from a river or the sea.

A notable case of the last is that of south-eastern Alaska, as described in Article 4 of the Convention of February 28th, 1825. Such boundaries are exceedingly difficult to lay down on the ground, requiring, too, beforehand laborious mathematical calculations. The Railway Belt of British Columbia, extending twenty miles on each side of the Canadian Pacific Railway gave the writer an example of such computation.

A river, and least of all a large river, a commercial artery, forms an undesirable international boundary. The very nature thereof makes it a route of travel, and hence of settlement on its banks, which, if in possession of two countries, is almost sure to lead to trouble. Hence we find few or no large rivers forming such boundaries, although our own St. Lawrence does for a short distance separate us from our southern neighbor. A summit or watershed boundary is pretty satisfactory, if restricted to mountains, but when applied to plains or undulating country, is fraught with difficulties. The difficulty consists in establishing the line of watershed, as was presented in the Maine-New Brunswick controversy early in the century.

Of the several classes of boundaries spoken of, none is as immutable as the astronomic one. Of the first, the original monuments and records may disappear, and personal evidence be wanting. Of the second or physical boundary, time may bring about changes quite marked and cause the line to move therewith. As a well-known instance, the Mississippi may be cited. In a recent report of the "Idaho and Montana Boundary Line"

we have another illustration. It is stated that: "from a geological standpoint, but hardly from a practical one, however, there is another reason why monuments should not be placed on the summit of the Bitter Root range, as marking the boundary line between Idaho and Montana. There is abundant evidence that the summit is what is known as a retreating or migrating divide; in other words, the waters tributary to the Bitter Root River in Montana are continually capturing by erosion those of the Clearwater river in Idaho, so that the divide is slowly being shifted to the westward, thus adding to the territory of Montana and diminishing that of Idaho. The existing divide is uniformly from six to eight miles from the irregular line representing the original divide, if the latter may be accepted as having passed through the highest points of the range, which seems probable."

When a boundary is defined by a parallel of latitude, the question invariably arises, in the demarcation of it, whether the astronomic or mean parallel is to be adopted. The astronomic parallel is that line on the surface of the earth on which direct observations for latitude give the same elevation of the pole; geometrically, for the spheroid or ellipsoid of revolution, it is the intersection of the cone, having its apex in the minor axis of the earth and making an angle therewith equal to the complement of the latitude, with the surface of the earth. Principally owing to the local deflection of the plumb line, points astronomically determined in latitude will not "close," that is, the line projected or run from one station as a parallel will not meet the next point or astronomic station.

That line with reference to which the sum of the discrepancies north is equal to the sum of those south is the mean parallel.

However, as the latter can only be determined *after* the location and connection of the astronomic points, entailing revision of the whole work, and besides the difficulty of re-establishing points on the mean parallel in case of loss or disappearance of monuments and marks, it has generally been decided to adhere to the simpler and more readily established astronomic parallel. All such parallels traced upon the earth are irregular curves.

The International Boundary Line, between the Lake of the Woods and the Rocky (Stony) Mountains is defined in the second

article of the Convention of 1818 as being the parallel of 49 degrees north latitude. The immediate cause of the delimitation of the boundary was the discovery that the fort of the Hudson's Bay Company at Pembina was nearly a mile within United States territory.

The field work was begun in September 1872 and finished in the same month two years later, while the proceedings of the joint commission were brought to a conclusion May 29th, 1876.

On this line of 860 miles, 40 astronomic stations were established, and 388 monuments erected.

After due consideration, the commissioners agreed upon the astronomic parallel. The recommendation for this, by the chief astronomers of the commission, was based on the following grounds: "1st That the portion of the parallel of 49° included within the operations of the commission, being only about one twentieth of the entire circle of latitude, was not sufficient to fix, with any mathematical accuracy, the true position of the mean line of 49°, and that, therefore, if such a parallel were described, depending on the mean of the astronomic stations, no known point of the boundary would be in latitude 49°; 2nd That as the amplitude of the arcs, included between the mean and the astronomical parallels, would in many cases be very considerable, grave errors and complications might arise in the subsequent re-survey of any lost portion of the boundary; 3rd That the definition of a mean line would involve a re-adjustment of the whole boundary, after the first careful survey should have been completed, and consequently a very considerable increase of expense, without any practical benefit accruing; 4th That for every purpose except that of geodetic computation, a parallel of points determined astronomically (instrumental errors aside), is a true parallel of latitude, and therefore, fulfils the stipulations of the treaty under which the joint commission was organized."

Accordingly, astronomic positions were determined at approximate intervals of twenty miles. These stations were connected by tracing upon the ground tangents to the prime vertical circles at each successive point. From these tangents, checked and corrected for errors of azimuth, the calculated offsets to the small circle of latitude were measured at convenient intervals,

varying from one to three miles. From the last mentioned offset the relative station error (deflection of plumb line) was found and distributed between the two stations in the ratio of the distances where offsets were taken. From this method it results that the boundary line, as actually traced, is an irregular curve, affected at each astronomical point by instrumental errors and by the local deflection of the plumb line, making the closest probable approximation, at every point, to a true astronomical parallel.

Of the forty astronomical stations on the 49th parallel, four were observed jointly, seventeen by the United States astronomer and nineteen by the British. The mean of the probable errors of the British stations was $\pm''.088$ and of the United States $\pm''.059$. The average of the probable errors is then a little over seven feet.

The greatest difference of station errors is $13.''89$ or 1,407 feet, being in a distance of 97 7/10 miles, between the Cypress Hills to the north of the boundary, and the Three Buttes or Sweet Grass Hills near, and to the south of the 49th parallel. The station error of the former is $+ 5.''94$, of the latter $- 7.''95$, that is the Three Buttes pulled the 49th parallel 805 feet south, and the Cypress Hills 602 feet north of the mean parallel. The greatest discrepancy between adjacent stations, about twenty miles apart, is $7.''28$ or 738 feet, near the Three Buttes.

Looking at the accompanying diagram, in which the upper figure is a representation (much exaggerated) of the relative position of the astronomic and mean parallels, while the lower figure shows the main features of the topography for a distance of about thirty-five miles on each side of the boundary line, the large deflections appear obvious from the topography. From the Lake of the Woods, westward, into the valley of the Red River, the station errors increase, and for a reason, which from our lack of knowledge of the underlying strata, must be conjectural. The escarpment of the Pembina Mountains, (elevation would be a more appropriate term, height 1,695 feet), naturally draws the vertical southward, continuing to do so until the Turtle Mountains (of moderate elevation, 2,550 feet) are reached, which too deflect to the south. After entering the Côteau of the Missouri we pass along the southern base of the high ridge, separating the waters flowing into the Gulf of Mexico, from those flowing into Hudson's Bay, and find, naturally, a deflection to the north, increasing to a

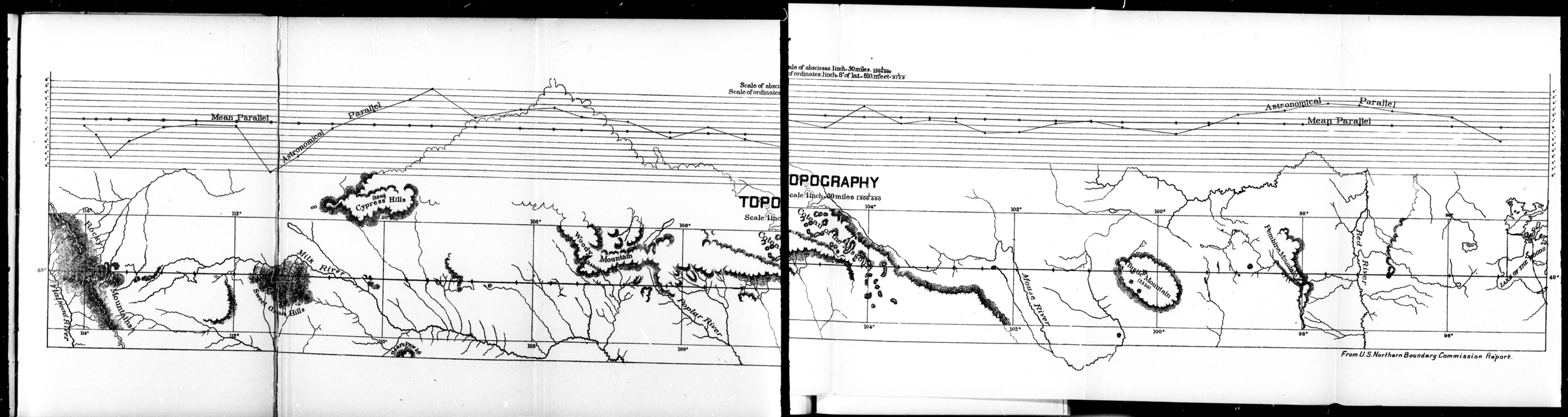
maximum, south of the Cypress Hills (3,800 feet). Here the enormous intrusive masses of the Three Buttes, produce a violent disturbing effect, drawing the astronomical parallel to the south, at an average rate of 14 feet to a mile, for a distance of about one hundred miles. When we actually enter the tumultuous Rocky Mountains, with all their varied conditions of compositions, of faults and dykes, and our lack of hypsometric maps, we are unable to even make a plausible estimate in which direction the local deflection is to be expected. Even the relative deflection between adjacent stations remains unknown in most cases on account of the great difficulty in connecting them geodetically.

As a very remarkable example of the deflection of the plumb line may be mentioned, the one on the arc of the meridian between Andrate and Mondivi, in northern Italy, where in a distance of a little over seventy-seven miles, a difference of nearly forty-one seconds was found, that is to say the difference in the distance between those two terminal points determined by direct astronomic observation, and also linearly by triangulation was found to be about four tenths of a mile. How much of this quantity is attributable to each place for local deflection, and again how much is due to relief or topography, and how much to the unequal distribution of masses beneath the surface of the earth, is not known.

It is evident that observations at two places which are also geodetically connected, can only give the relative deflection of the plumb line.

For the boundary between the Lake of the Woods to the summit of the Rocky Mountains, the Commissioners agreed that the line joining any two adjacent monuments shall be an arc of the parallel. This was to apply, too, in the case of restoring any monument whose position was lost. This agreement differs from that of the boundary commissioners, who had charge, some 17 years previously of defining the boundary from the Gulf of Georgia to the summit of the Rocky Mountains. They agreed that the connecting line between monuments shall be a straight or direct line, i.e. an arc of a great circle.

The international boundary commission appointed to define the boundary under the first article of the Treaty of June 15th, 1846, (the present southern boundary of British Columbia) was


Mean Parallel
Astronomical Parallel
Scale of abscissas 1 inch = 30 miles
Scale of ordinates 1 inch = 8' of lat. = 810 feet
TOPOGRAPHY
Scale: 1 inch = 30 miles
Rocky Mountains
Milk River
Cypress Hills
Bear Paw Mts
Sweet Grass Hills
Wood Mountain
Poplar River
Missouri River
Moose River
Turtle Mountain
Pembina Mountain
Red River
Lake of the Woods
From U.S. Northern Boundary Commission Report.

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organized in 1858 (first meeting August 13th), and in the summer of the same year began the field work at the western terminus of the boundary. The observations and surveys were carried eastward under great difficulties, owing to the heavy forest and mountainous character of much of the country. Early in 1862 the field work was completed and the preparation of the maps begun, which were, however, not completed and jointly signed by the commissioners till 7th May, 1869. A report was never published.

Between the extreme east and west points, upon the watershed of the Rocky Mountains, and the eastern shore of the channel which separates the continent of North America from Vancouver Island in west longitude 114° 03′ 34″ and 123° 3′ 53″ respectively, the exact length of the boundary line upon the 49th parallel of north latitude is 409 4/10 miles. The position of the parallel was determined by 28 astronomical stations, 11 of which were established by the British Commission, 14 by the American Commission, and 3 were observed by both. Another station was fixed by the British Commission at Schweltza Lake, but it was at the time rejected on account of the apparently large deflection of the plumb line, though the after experience of the most accurate instrumental observations in that mountainous country, led to the conclusion that the result at Schweltza was quite as trustworthy as any of the others. It is, however, not included in the final determinations.

At the first meeting of the Commissioners at Semiahmoo, Aug. 13, 1858, it was concluded, after discussing plans for determining and marking the line as far as the Cascade Mountains, to be inexpedient at that time, in consequence of the great expense, consumption of time, and the impracticable nature of the country, to mark the whole boundary by cutting a track through the dense forest. It was therefore agreed to ascertain points on the line by the determination of astronomical points at convenient intervals on or near the boundary ; and to mark such astronomical stations or points fixed on the parallel forming the boundary, by cutting a track of not less than 20 feet in width on each side for the distance of half a mile or more, according to circumstance. Further, that the boundary be determined and similarly marked where it crosses streams of any size, permanent

trails, or any striking natural features of the country. In the vicinity of settlements, the line was to be cut a greater distance. Bessel's value of the figure of the earth was adopted.

From the two points on the parallel, dependent, respectively, on the Sumass and Schweltza astronomical stations, cuttings were made to connect the points. When the cuttings met, there was found to be a discrepancy of 8″, say about 810 feet; they were, however, connected, though the line thus defined is obviously not strictly *the* boundary of the treaty. The distance is about 9¼ miles. This relative deflection of the plumb line, 8″, in so short a distance, is the largest on the whole 49th parallel, from the Lake of the Woods to the Pacific. When the cuttings on the parallel from Sumass and the British station at Semiahmoo met, there was a discrepancy of 114 feet in the twenty miles, and between the U. S. astronomical station at the east shore of Semiahmoo Bay, and the British one five miles east thereof, a discrepancy on the parallel of nearly nine feet was found, an error quite within the error of observation.

The only other cutting on the whole boundary line west of the Rocky Mountains, connecting adjacent astronomic stations is between the Similkameen and the Columbia rivers, a distance of 96 miles. The stations there in order eastward are: Similkameen (U.S.); Lake Osoyoos (Br.); 1st Crossing Newhoilapitkw (U.S.); 2nd Crossing Inshwointum (Br.); 3rd Crossing Statapoosten (U.S.); and on the Columbia (Br. and U.S.) From the point on the parallel at Lake Osoyoos, a line was run east and west 30 1/5 miles, connecting with similar points at Similkameen and at the 1st Crossing. The line was found to strike 509 feet north of the former point and north of the latter 364 feet, showing a marked deflection of the plumb line. When, similarly, an east and west line was run from a point on the parallel at Inshwointum, it was found to be south 300 feet of the point on the parallel at the 1st crossing, and 180 feet north of the point at Statapoosten.

This shows, therefore, a discrepancy between the latitude of Lake Osoyoos (Br.) and Statapoosten (U.S.) of 844 feet, due to local attraction or difference of local attraction. After verifying the accuracy of the latitude observations, it was decided to adopt the mean parallel, based on the differences found, between Similkameen and Statapoosten—a distance of 71 miles. This is the

only part of the whole boundry line between the Lake of the Woods and the gulf of Georgia, where a mean parallel has been adopted for the boundary, instead of the astronomic parallel. These seventy-one miles were re-cut on the mean parallel. From the extremity of the mean parallel at Statapoosten, an east line was run to the Columbia, where a difference of 212 feet was found between the mean of the British and United States latitude determinations there and the mean parallel. The line (for final boundary) was thereupon deflected from Statapoosten so as to strike the above mean Columbia position of the 49th parallel.

The actual definition of the boundary is as follows: Its western extremity is marked by a substantial granite obelisk in longitude 123° 03′ 53″, west, standing upon a steep cliff on the western face of the promintory of Point Roberts, about 160 feet above the sea. For 44.8 miles eastward there are 42 iron pillars placed at suitable points on the boundary. One pillar stands on the eastern face of Point Roberts, 2 miles 704 yards from the obelisk, and there are two intermediate pillars in the interval at average distances apart of somewhat more than ¾ mile. A pillar on the west shore of Semiahmoo Bay is 12 miles 1,177 yds. from that on Point Roberts on the opposite side of the bay; and thence in 29¾ miles to the eastermost pillar the average distance apart is about 1380 yds., varying between 1 mile 1245 yds. and 198 yds. on the opposite bank of the Sumass River. These pillars all stand in a continuous cutting through the forest or in intervening patches of swamp and prairie. From the eastern-most iron pillar, to the right or west bank of the Similkameen river is 107.9 miles, the boundary is defined in the vicinity of 9 astronomical stations by 19 cairns or pyramids built of dry stones, and one bench mark cut on the face of a rock at Ensakwatch; and at several stations short vistas were also cut in the forest, between the cairns. This wide interval comprises the rugged and inhospitable region of the Cascade Mountains. One of the widest unmarked intervals on the boundary occurs in these mountains, between Pasayten and Naisnulch, the distance between the marked points being 23.7 miles. From a cairn at the foot of the mountains on the west side of the Similkameen river to the east or left bank of the Columbia, the boundary for 95 miles is well and continuously marked by 69 stone cairns and one mound of earth, and by forest cutting in all necessary cases.

This was the most favorable portion of the work, part of the line passing over rolling prairie country interspersed with wood ; but very considerable portions were also mountainous, rugged and heavily timbered, though more accessible from the valley of the Newhoialpitkw (Kettle) river than were the Cascade Mountains. Two cairns stand within 129 yards of each other on the east bank of the Columbia (one having been placed by each Commission) and the average distance apart of the remainder is 1 mile 679 yds. From the hill tops the line of boundary defined by cairns and cuttings can be traced for many miles. For the remaining 161.8 miles between the eastern cairn on the left bank of the Columbia river and the terminal point on the watershed of the Rocky Mountains in west longitude 114° 03′ 28″, the boundary passes over successive mountain ranges intersected only by the valley of the Kootenay River at two points 75¾ miles apart and by the adjacent valleys of the Flathead river and its tributary Kishenehu creek. This portion of the line is marked in the vicinity of 9 astronomical stations, by 26 cairns and one bench mark cut in the face of the rock at the Kootenay Mountain Station, and by a cairn fixed by survey on the trail between Kootenay west and Mooyie station ; and the usual forest vistas were cut at the usual defined points, besides longer cuttings of 7 and 10 miles at the eastern crossing of the Kootenay, and between the Flathead and Kishenehu rivers. On the summit of the Rocky Mountains the monument consists of a pyramid of dry stones, situate on a narrow saddle with precipitous sides connecting two lofty mountains, serving to identify the locality between the Columbia and the Rocky Mountains, exclusive of the Mooyie trail cairn, and the intervals between the Kootenay mountain and Kootenay west stations, and Mooyie and Yahk stations, the distance between the consecutively marked points at the several astronomical stations averages about 13¼ miles ; but between the stations named they extend to 25 and 24 miles owing to the inaccessible nature of the intervening country which is quite as bad as the Cascade Mountains.

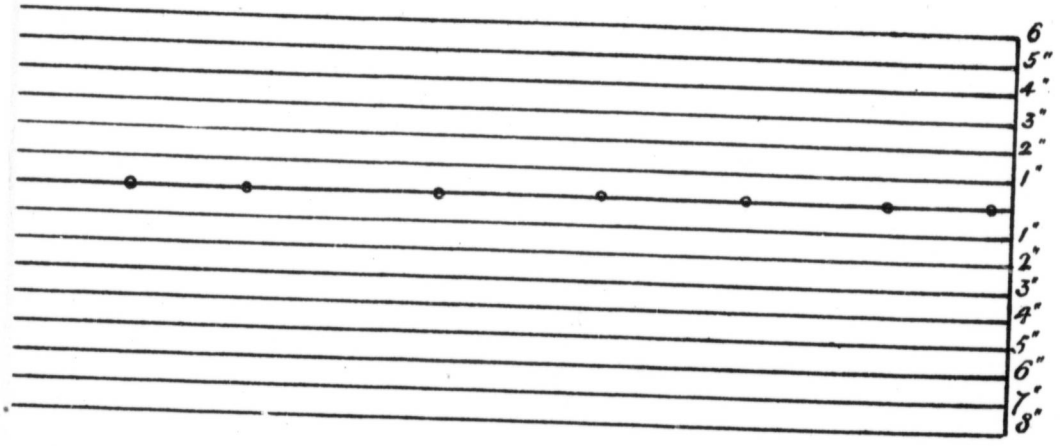
As already stated, the Boundary Commissioners had agreed to understand the boundary laid out by them, to consist of a series of straight lines between the successively marked points, without regard to the distances between those points or the curve

of the parallel in the longer intervals. That they did upon the consideration that it was of the greatest importance that nothing should be left for future discussion of settlement, and that the operations should be final and conclusive. It may be stated that opposite the centre of a chord of 25 miles in length, the departure from the 49th parallel would be about 40 yards, and of 12 miles, 9 yards. Both these departures are probably far smaller than the deflection of the plumb line, at the governing astronomical stations.

We have, therefore, in the actual boundary line of British Coulmbia, a deviation from the 49th parallel, as given in the treaty of 15th June, 1846, in so far, that the straight lines replace the curve of the parallel between all the stations, and furthermore, that between Similkameen and Statapoosten, the mean parallel was adopted instead of the astronomically determined points.

We have followed now the 49th parallel for 1,270 miles, about one thirteenth of its circumference, and it has disclosed to us some of its vagaries as manifested in the latitude component of the deflection of the plumb line. This boundary line is the longest astronomic one on the earth, the nearest approach to it being the meridian separating West Australia from North and South Australia.

The same law or force which causes the deflection of the plumb line, determines the length of the seconds pendulum, preserves the planets in their orbits, and maintains the stability of the universe—is the law of gravitation. Our earth furnishes us with many interesting problems, and the very discordances observed—apparent though they are—tend to lead us on to uuravelling the mysteries and intricacies of nature, and to unfolding the unity and harmony of the cosmos.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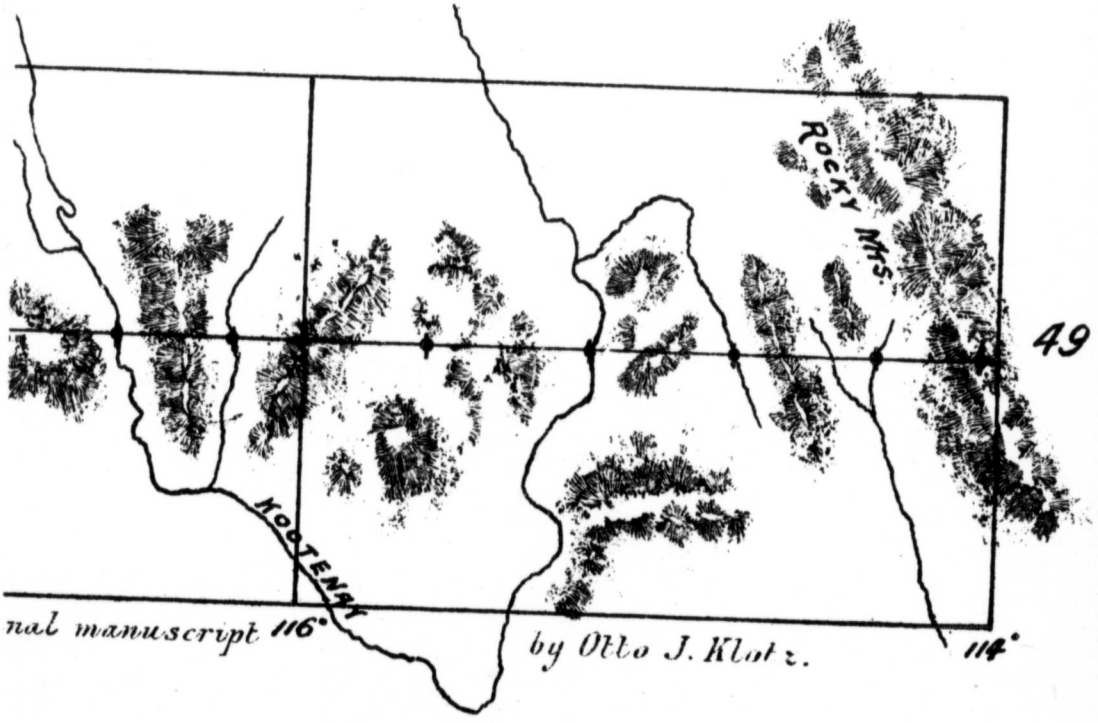
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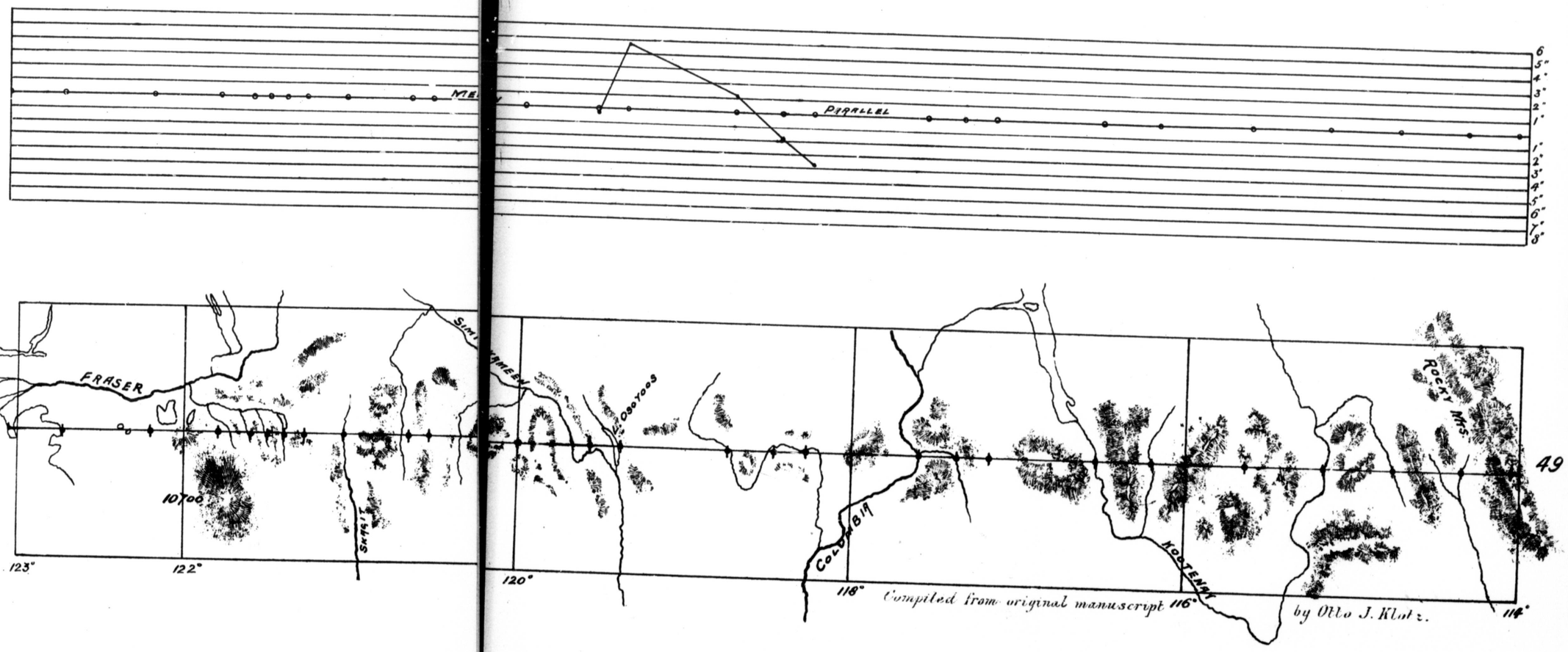

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FISH CULTURE IN CANADA.

By Professor E. E. Prince, Dominion Commissioner of Fisheries, Ottawa, President of the Society.

(Read March 23rd, 1900)

Fish-culture is, at once, one of the most ancient and one of the most modern of human pursuits. It is one of the most ancient, for the Chinese at a time so remote that it cannot be determined, are known to have reared fish, not only as quaint ornamental pets, but for use at table; and we know that the Greeks and Romans fully appreciated the utility of the artifical culture of fish. Lucullian feasts would have been impossible, but for the fish-pond's ample supplies. The ancients, says one authority, "were not satisfied with stocking fish-ponds which they had constructed for the purpose, but carried their foresight to the point of filling lakes, formed by nature, with the spawn of fish which they threw into them." (Columella, De Re Rustica Bk. viii., Sec. 16). In Christian times, fish-culture was not neglected and the mediæval monasteries were always provided with a fish-pond, ensuring suitable fare for Friday feasts. A fish-pond was regarded as necessary, no less than the buttery, the brewhouse, and the kitchen.

Protection of adult fish and systematic fattening were the main features of old-world fish-culture, but the Chinese as the French Jesuit, Jean Baptiste Duhalde, has recorded, procured the eggs of fishes, and cared for them in hatching tanks. The Romans, as we have seen, adopted the Chinaman's plan to some extent.

Modern fish-culture, to adopt a Hibernicism, has taken a great step in advance by taking the process a step further back, and by manipulation of the parent fish secures the ripe eggs, controls their fertilization, and incubation, and rears the fry, when hatched, to a more or less advanced stage of growth.

A French monk, Dom Pinchon, has been credited with first accomplishing, in the fifteenth century, the artificial fecundation of trout eggs; but competent authorities are of opinion that he simply collected naturally impregnated eggs. It was not until 1747 that a Westphalian officer, Lieut. Ludwig Jacobi experimented with the eggs of fishes, by actually mingling the milt and eggs, and carrying out fish-culture from the fecundation of the ova to somewhat advanced stages of the liberated fry or young brood. He reared trout until they were six months old, and founded modern fish-culture in the true sense of that term. The importance of his work was fully recognized, for his memoir was printed in Paris in 1770, and King George the Third, granted him a life pension in the following year. Karl Lund, in Sweden, followed close in the wake of Jacobi. In Italy, Rusconi (either in 1834 or 1835), and in Switzerland, Agassiz and Vogt, about 1836, minutely investigated the early stages of the eggs and young of fishes, while John Shaw, in the year of the Queen's Coronation, Knox, Young, Boccius, and others, from 1840 to 1850, added considerably to our knowledge of the larval development of the salmon and other species of fish. Rémy and Géhin, two French fishermen of La Bresse, appear to have practised fish culture in France in 1842, and the subject was brought to the attention of the public by the notable treatises of de Quatrefages and of Coste, the latter organizing in 1850, a large fish-breeding establishment with the authority of the Minister of Agriculture. France has ever since maintained a high place in the world of aquaculture.

It was not until 1853, so far as I can ascertain, that any attempt was made upon this continent to artificially breed fishes. Dr. Theodatus Garlick of Cleveland, Ohio, was the pioneer. He obtained parent brook-trout in Canada, taking them across from Port Stanley in Ontario, to his establishment in Ohio. He was an enthusiast, and his exhibits of young fish, hatched from Canadian trout-eggs, were a feature for many years at Agricultural Exhibitions in the various States bordering on the great lakes. Canada soon followed suit. The initial attempts were, of course, largely experimental. The late Mr. Samuel Wilmot claimed to have originated fish-culture in Canada ; but I find the claim to be disputed, and with justification, by a venerable

and respected citizen of Ottawa, Mr. Richard Nettle. Stimulated no doubt by recollections of famous streams in his native Devonshire Mr. Nettle, as early as 1856 or 1857, began the incubation of salmon and trout eggs for purposes of artificial stocking, in hatching tanks in the City of Quebec. He disputed the accuracy of the claim frequently put forward on behalf of Mr. Wilmot. The Bishop of Ottawa, (Dr. Hamilton) incidentally confirmed the claim of Mr. Nettle in a recent conversation, his lordship informing me that he himself saw the young fish and the hatching arrangements about the time referred to. Mr. Nettle was then Superintendent of Fisheries for Lower Canada. From a report by the late Mr. Wilmot, dated Dec. 31st, 1878, it appears that he commenced experiments in fish-hatching in 1865, eight or nine years later than Mr. Nettle's experiments, and he carried it on as a private enterprise until the Dominion Government took the work over and gave Mr. Wilmot an appointment as a Government official. In 1866 Mr. Wilmot acted as a fishery officer, with authority from the Government of Upper Canada, and on May 30th, 1868, he became an officer under the Department of Marine and Fisheries; but it was not until eight years later (1876) that he became Superintendent of Fish Breeding. For his initial experiments he was paid, in 1869, the sum of $2,000 by Order in Council.

Thus fish-culture in Canada, at first a private enterprise on a small scale, received a kind of semi-official sanction, but in 1868 it became distinctively a branch of the Dominion Government service, the Newcastle Hatchery, possessed by Mr. Wilmot, being transferred to the Department of Marine and Fisheries. This hatchery, Mr. Wilmot affirmed, in his report dated Feb. 3rd, 1875, "has been the nucleus from which all of the National and State fish-breeding establishments in Canada and the United States of America have taken their rise." Additional hatcheries were soon built, the famous Restigouche Salmon institution in 1872, (twice rebuilt), and the Miramichi Hatchery in 1873. In 1874 the Gaspe Hatchery was commenced, and in 1875 a large mill was purchased at Tadoussac and converted into a fish-breeding establishment, supplanted by a new building later. The work expanded, so that Mr. Wilmot, in Feb. 1875, was able to speak of five hatcheries in Canada, four of them in full operation.

Much interest naturally centres in the Newcastle Hatchery on Lake Ontario, where thirty-five years ago the work commenced. The building, enlarged and improved, is situated on a small stream at the head of a small creek or marsh opening into the lake near Bowmanville, and about thirty-five miles east of Toronto. A sheltered and secluded valley of great sylvan beauty encloses the site, but the work has always been handicapped by its distance, both from good spawning grounds, and from suitable areas for planting the fry. Mr. Wilmot erected the hatchery, as was natural, near to his own residence, and at a time when salmon frequented Lake Ontario, and resorted to the creek in question for purposes of spawning. For many years salmon have been practically extinct in these waters, and the hatchery failed in its original purpose of keeping up the supply of Lake Ontario salmon, which Mr. Wilmot claimed to be indistinguishable from the sea-going Atlantic Salmon. From 1868 to 1873 over a million fry were sent out from this parent hatchery (an average of 200,000 per annum.) A small private hatchery was also carried on during these earlier years of Canadian fish-culture, by the well-known salmon fisherman and merchant, the late John Holliday. Mr. Holliday was born on the banks of the famous salmon river, the Scottish Tay, and was stimulated, no doubt, by the salmon-culture work at Stormonthfield, in Perthshire, commenced in 1853 by the proprietors of the salmon fisheries on the Tay. He built a hatching establishment on the Moisie River (north shore of the Gulf of St. Lawrence), which has continued its operations to the present time. Messrs. Brown and Co., also erected a trout hatchery at Galt, Ont., and, in 1868 had no less than 10,000 parent trout impounded in one of their ponds for the purpose of taking spawn for hatching purposes. Other hatcheries privately conducted with zeal and success might be named, such as the Credit Forks Hatchery carried on by Mr. Chas. Wilmot, the Silver Creek establishment near Toronto and others.

In the United States, it was not until 1871 that fish-culture became a recognised department of work under the auspices of the Federal government. Previous to that year individual States had made attempts in this direction, indeed, New Hampshire in 1865 had commenced fish-hatching operations, and agents were sent to

the rivers of Canada, where they were permitted (as Mr. Charles G. Atkins tells us) to take salmon from the spawning beds, and were thus enabled to secure some hundreds of thousands of eggs, which were "hatched with a measure of success." Pennsylvania and the State of Connecticut followed in 1866. In 1867, 1868, 1869 and 1870 the States of Maine, New York, California, New Jersey, and Rhode Island, severally began fish-culture in their respective territories.

In Canada the salmon and brook-trout naturally claimed first attention ; but in 1867 and again in 1868, whitefish were successfully impregnated and hatched by Mr. Wilmot as he tells us in one of his reports. A pioneer fish-culturist in the United States, Mr. N. W. Clark of the State of Michigan has been credited with first successfully handling the eggs of the whitefish (*Coregonus clupeiformis*) on this continent, but the statement published by Mr. Wilmot gives four or five years priority to the Canadian, if, as Mr. Clark said, the first whitefish eggs in the United States were artifically hatched in 1872 (see U. S. Fish Comm. Report, p xxvi, 1872-73). In 1875 a whitefish hatchery of large capacity was completed at Sandwich, Ontario, and has carried on, with marvellous success, the incubation of the eggs of that species on the Detroit River.

Under the zealous and indefatigable Samuel Wilmot, fish-culture in Canada made rapid strides, and the Dominion has generally been acknowledged to be in the front rank in this work. France and Germany were in advance, it is true, so far as exact scientific methods and knowledge were concerned, and the United States has taken the lead in making most munificent provision from the public funds for pisciculture, and Great Britain has set a worthy example in private enterprises and in costly experiments under skilled superintendence, witness the Stormouthfield*, Howietown, Cray's Foot, and Guildford establishments.

. Canadian fish-culture was no doubt conducted in a rough and ready manner, the Superintendent and his staff being practically self-taught, so that many blunders were committed, and many erroneous methods for some years adopted. But the conditions were so favourable, the purity of the water and the abundance

*Now supplanted by Dupplin

and coldness of the supply, the robust and healthy nature of the parent fish, and similar circumstances compensated for much that was lacking in manipulation and technical knowledge, during the early years of Canadian fish-culture. "The most important requisite . . . . is pure water, it is indeed to a hatchery what coal is to a steam-engine" said the late Sir James Gibson Maitland (Int. Fisheries Exhib. London 1883) to whom Scottish fish-culture owed so much. It may be doubted whether any other country can offer conditions so favourable as Canada, and it is certainly remarkable that in the vast number of fry of various species, hatched year after year in the Dominion hatcheries, abnormal or deformed fishes hardly ever occur. Monsters as a rule are familiar enough in the tanks of European hatcheries, but nothing is so rare in Canadian establishments.

The following brief *resume* of the progress of fish-culture operations in Canada gives at a glance the stages of its advance. The Newcastle (Ont.) hatchery, as already stated, came under government control in 1868, or rather 1867, and there have been hatched, since that date, Lake Ontario salmon, Pacific spring salmon,* brook trout, black bass, German carp, Great Lake trout, dorè or pike perch and lake whitefish. Ontario salmon became practically extinct within a few years after the hatchery was started, and Pacific salmon do not appear to have thriven, one or two questionable records only of their capture having been announced, while black bass proved only partially successful and carp were a total failure. Brook trout, being mainly a game fish and of inferior commercial importance, was eliminated in 1892, though its culture was a marked success. Thus the hatchery has confined its work to the incubation of Great Lake trout, the eggs being secured by government officers at Wiarton, Georgian Bay, and the Lake whitefish, transferred from the Sandwich hatchery, early in the year, generally February, in the eyed stage.

The following table embraces details respecting the remaining 14 hatcheries arranged for conciseness and convenience of reference.

*Professor Spence F. Baird generously sent from the United States at various times eggs of the Quinnat or Spring salmon.

FOUNDED	LOCATION.	KIND OF FISH HATCHED.	ANN'L OUTP'T
1874	Deeside, Restigouche R.	Salmon	1 to 3 millions
	South Esk, Miramichi R.	Salmon and Sea Trout	1 to 1½ "
1875	Tadoussac, Saguenay R.	Salmon and Hybrid	
	Gaspé, P. Q.	Ouananiche	1 to 3 "
		Salmon	1 to 1½ "
1876	Sandwich, Ont.	Whitefish, Pike Perch or Dore	10 to ov'r 70 mil
	Bedford near Halifax, N. S.	Salmon, Whitefish and Great Lake, and Rainbow Trout	1 to 5½ mill'ns
1880	Grand Falls, St. John R. N. B.	Salmon Whitefish and Great Lake Trout	2 to 4 "
	*Dunk R, P. E. Island	Salmon	1 "
1881	Magog near Sherbrooke, P. Q.	Whitefish and Great Lake Trout	1 to 4½ "
1882	*Sydney, Cape Breton.	Salmon	1 to 2 "
1884	New Westminister, Fraser R., B. C.	Pacific Salmon (Quinnat and Sockeye)	2 to 10 "
1890	Ottawa Hatchery.	Whitefish and Great Lake Trout	3 to 7 "
	Bay View near Pictou, N. S.	Lobsters	60 to 100 "
1894	Selkirk, Red River, Manitoba.	Whitefish	4½ to 19 "

The total quantity of fry of all kinds distributed from the foregoing institutions since fish-culture has been carried on by the Dominion government, that is from 1868 to 1899, both years inclusive, is no less than 2,650,468,200. The average annual quantity during the last 20 years has been 128,000,000. In 1895 the output was extraordinarily large, amounting indeed to nearly 300 millions. For the last nine years vast quantities of lobsters have been hatched, the annual average being no less than 100,000,000. Deducting these from the total output, we find that the average output each year, during the last twenty years has been 85 millions, mainly of the three kinds, salmon, Great Lake trout and lake whitefish (*Coregonus*), which are all fishes of great economic value.

Whatever may be said for or against the artificial hatching of fish, no fair-minded critic can doubt, that the distribution year after year, of this enormous quantity of young fish must have benefitted our waters to an incalculable extent. Artificially hatched fry, unlike those hatched naturally on the spawning beds, must in the eyes of some critics, be more at the mercy of enemies when newly planted. Nothing, however, could be more helpless and unprotected than naturally hatched fry, and those turned out from hatcheries are really less at the mercy of enemies, inasmuch as they are always some days old, frequently several

*Dunk River hatchery was destroyed by fire and Sydney hatchery has not been operated for three seasons pending the completion of a new Cape Breton hatchery.

weeks old, before being planted, and should be more sturdy and robust than the fry exposed immediately after hatching, on the natural spawning beds. Nor is the objection better founded that the fry are suddenly transferred from the warmer water of the hatchery to the colder water of the lake or river outside. Records, which have been kept, show that the water flowing rapidly and plentifully through the tanks is more equable and cold than the shallow waters outside. The fry, it is further contended, are untaught to seek shelter, and must be gobbled up by watchful enemies. This cannot be so. The eggs are all taken from wild fish, and the young inherit the instincts of their parents. Hence when the fry have been carefully watched at the time of planting, they have been noticed to act with alertness and intelligence, and at once dart off to shelter. All the stock objections are made in ignorance of the real facts, for the facts all prove the very opposite of the theories set forth by critics, usually arm-chair critics.

Fish-culture, at this late date, needs no advocacy or defence, yet recent unsolicited testimony may be adduced, sent to me as affording evidence of the success of the government hatcheries. A lake near Three Rivers, P. Q., was planted several years ago. It abounds at the present time with fine lake trout, says the member of parliament, who is my informant, although these fish did not formerly occur in it at all. A lake in Victoria county, Ontario, I have recently been informed by residents, is alive with trout consequent on being stocked by means of fry. Most visitors to the river Saguenay know the Tadoussac Hatchery, and the small lake adjacent to the building abounds in small salmon a few pounds in weight, the result of the surplus quantities of fry placed there by the hatchery officer. "On one occasion," says the officer in an official report "I permitted the Bishop of Chicoutimi, to fish in the hatchery lake. He was accompanied by the Rev. Mr. Mathieu, Superior of the Quebec Seminary, and the Rev. Mr. Lemieux, of Tadoussac, they were astonished at the number of young salmon that could be caught." A most convincing case came to my notice, however, on the testimony of a gallant and facetious member of the House of Commons, who bitterly complained that a New Brunswick lake, stocked with brook trout at much cost, had received also some Great Lake trout from a

Government Hatchery. The latter have so prospered and grown in size and numbers, that they are cleaning out the brook trout, formerly so aburdant in it. The Club who lease the lake are anxious to exterminate the hordes of huge lake trout which are the direct result of fry planted there from Grand Falls Hatchery, and the use of nets has been resorted to, enabling some fine specimens of these "fresh-water sharks" to be captured. Deplorable as are the results from the Club's point of view, no better testimony to the success of the government's hatchery work could be adduced.

To most people fish-culture is thought to consist in taking some ripe mature fish, just before spawning, squeezing eggs from them, fertilising them, and placing them in jars or on trays, in a current of water until the young fish hatch out. Fish-culture is, however, much more than that, it includes at least half-a-dozen different methods. Of course, one method, and that most familiar, consists in obtaining ripe living fish of both sexes, and after subjecting them to the same process of careful and gentle pressure, mingling the two products in a spawning vessel or dish, where the eggs are rapidly fecundated, and then transferring the vivified eggs to the trays or hatching jars. The parent fish, being handled with care are returned to the water, with rare exceptions, alive and unharmed, and in the case of salmon usually continue the ascent up-stream, which had been interrupted by the hatchery officials. In B. C., it is said, the spawned fish frequently descend, but this may depend upon the sex, for Frank Buckland noticed that male salmon invariably bolt up-stream if disturbed, whereas the "hens" or female salmon bolt down stream. The fish do not die, as the signs of ripeness are readily visible to the expert officer's eye, and ripe fish are spawned painlessly and with the utmost readiness and ease. It is a curious fact that eggs from dead fish may be successfully used if death is recent. Thus the distinguished Russian naturalist, Owsiannikoff, in a paper read in 1869, before the Imperial Academy of St. Petersburg, stated that he had fertilised the eggs taken from dead fishes, and in most cases with success. Different species also may be crossed and hybrids readily produced but there are limits to the process due, no doubt, to certain microscopic peculiarities in the structure of the egg capsule.

Two methods of fertilisation have been adopted, the wet and the dry, and the latter has almost universally superseded the former. In the dry method no water is added until some moments after the ova and milt have been mingled and gently stirred with a feather or the fingers. In the early days of Canadian fish-culture the wet method was followed, and the eggs were placed in water before the milt was added, and a proportion of eggs always failed to be fecundated, hence the universal adoption of the so-called dry method.

Some of the different methods followed in obtaining eggs or fry may be here instanced.

(1) The parent fish are secured some time (days or even months) before spawning, and impounded until they become ripe and swollen. Whitefish are often kept in this way, and the plan has been adopted in Canada of confining salmon in tidal ponds for many months, and apparently without harm. Indeed the salt water prevents fungus, and as salmon take no food after leaving the sea, there is no difficulty in retaining them until the spawning season, and then taking the eggs and milt. After being kept from June or July until October or November the parent fish are liberated on being artificially spawned.

(2) The parent fish are netted at the spawning time near the breeding beds. Salmon, in British Columbia, are treated in this way, also Great Lake trout and whitefish. The parent fish are rarely injured, and are thus liberated in their native waters.

(3) Parent fish are captured and the eggs taken and fertilised, but the fish are killed and sent to market. This is the plan adopted in some cases by U. S. fish-culturists, especially with the Great Lake trout. It is unavoidable as a rule, with black bass and sturgeon, even when very ripe, as they refuse to yield their spawn. It is not adopted in Canada.

(4) Parent fish are impounded in ponds or enclosures, where they deposit and fertilise their spawn naturally. The spawn is then transferred to the hatchery and incubated artifically. Bass, maskinonge, perch, carp, sturgeon, etc., have been treated in this way.

(5) A similar plan to the last is followed excepting that the eggs are allowed to hatch out in the ponds where deposited.

(6) Instead of securing the parent fish, or obtaining the eggs after being deposited, the small fry, incubated and hatched naturally, are netted and used for purposes of stocking waters. Trout and black bass have been mainly introduced into new waters by this method. Black bass, when very young, devour each other, even when only a little over an inch in length, and the Caledonia (N. Y.) Hatchery officers have reported that their young black bass grow so rapidly that they must be shipped immediately after being collected in the adjacent marsh ponds. Nearly 400,000 of these fry are annually distributed from the American hatchery named.

It is plain that if we can secure the eggs from the ripe parent fish, fertilize them by the dry method, and hatch them under the care of experts, the results must infinitely surpass those possible under natural conditions, where a small proportion only can be expected to surmount all the dangers and difficulties of their environment. Let me give an illustration of this waste of eggs on the natural spawning beds—a waste not contrary to natural law, but obedient to the principle of compensation and adjustment, universal in the world of nature. In 1895 I spent some time closely observing certain spawning beds of the Fraser River salmon, commonly called sockeye or blueback. I noticed, not once, but scores of times, pairs of fish busy nesting, the male fish lingering near his partner until she shed a shower of eggs. Just as the eggs were cast into the rapid stream, the male fish had his attention attracted by a rival, and darted with lightening speed to drive him off, both male fish tearing at each other with gaping jaws, armed with formidable teeth, the teeth at this time being of abnormal size. Time after time I saw female fish wasting their eggs in this way, for the eggs deposited in the gravel by the female, while her partner was engaged in a fight twenty or thirty yards away, were unfertilized and would, of course, perish or be eaten by hungry enemies, suckers, trout, etc., which hovered near in hordes.

The curious fact repeatedly noticed by observers, that male salmon outnumber the female; and the fierce fights and numberless resulting deaths, may be a device for reducing the surplus number of one sex. "To me it is the strangest puzzle," said Frank Buckland, "why the male fish always predominate over

the female,'' and he asserted that frequently there occurred seven males where there might be not more than one female salmon. During the second year of the Restigouche Hatchery's work, the late John Mowat reported that the male fish were in excess of the female as two to one, and the late Alexander Russell, in his famous book '' The Salmon,'' gave prominence to Shaw's not less interesting discovery, that in the young striped ''parr'' stage, male salmon are mature, '' the male parr (alone) arrives at sexual maturity, and does and can impregnate the ova of the adult female salmon.''

If, to the natural loss of enormous quantities of eggs by non-fertilization, be added the depredations of ducks, loons, herons and aquatic birds, not to speak of otters and four-footed enemies, as well as destruction by floods, by mud, gravel and ice, it is easy to see how great are the advantages offered by artificial incubation, and by caring for the eggs in properly equipped hatcheries.

Anglers, as a rule, favour fish culture, but there are exceptions, and the sportsman needs to be reminded that, whereas, the fish are liberated strong and uninjured after being artifically spawned, those taken by the angler's line shortly before the breeding season, are killed and prevented from fulfilling their task of peopling the waters with young brood. It is easy to hatch 90% of salmon eggs in a hatchery, whereas, Sir Humphrey Davy estimated that not six per cent. of the eggs deposited on the breeding grounds, come to perfection, and Stoddard held that only four or five fish fit for the table were the result of 30,000 ova on the spawning beds. The take of salmon in a single net may suffice to furnish enough eggs to keep up the supply of young fish, and it is the rule at the Government nets to liberate all fish not required, and these are allowed to ascend to the upper waters. Thus at the Tadoussac nets in 1889, 559 salmon were taken for the hatchery, but 310 of the largest were sufficient, and the remaining 249 were turned into the river again. This is frequently done. In most of the hatcheries reliance is placed upon the Departmental nets, managed by the hatchery officers. In these nets fish are trapped, and after being spawned are set free. In some cases parent fish are bought from local fishermen by special arrangement, but the plan has, on the whole, proved uncertain, as the fishermen asked exorbitant

prices, or ignored their agreement and shipped the fish straight from their nets to the markets, leaving the hatchery officers in the lurch. Many parties have entertained an ignorant prejudice against artificial hatching of salmon, not fishermen only, but men of education and social standing. Thus the lessees of certain rivers in Gaspe, refused to allow any salmon to be taken for hatchery purposes, and anglers who have been known year after year, to kill hundreds of salmon in famous pools, really spawning grounds, have declaimed against the inhumanity of taking the spawn from the small number of parent fish, which are ample for supplying a salmon hatchery.

Frank Buckland has truly observed that "the success of salmon egg-collecting depends upon very small circumstances, and he specifies seven necessary provisions to be made by the "spawner," viz, : a water-proof suit, spawning pans of large capacity, a long, shallow basket to hold the fish under water until wanted, hose flannel in yard lengths for wrapping the struggling fish when spawning, dry towels to wipe slime off the hands, moss and trays, and lastly, nets.

In a report published in the Marine and Fisheries Blue Book, 1896, I described all the types of fishes' eggs known to scientific experts. I grouped them under seven heads, according to their special features, and I pointed out that they varied in shape, size, external structure, etc. The smooth, spherical, pea-like eggs of the salmon, trout, whitefish, and the like, are far more favorable for artificial incubation than slimy eggs, eggs clinging in bunches, eggs in gelatinous strings, eggs covered with spines, oval eggs. and other varieties.

The eggs resembling peas vary in size in different species. A quart measure is frequently used in counting eggs on account of its convenience. The measure holds 57.75 cubic inches, and has been found to be capable of containing 3,300 land-locked salmon eggs ; 4,272 Atlantic salmon ; 3,696 Pacific salmon ; 5,525 Great Lake Trout ; 8,311 to 9,935 English Brown trout ; 12,063 to 13,998 American brook trout ; 24,363 striped bass ; 28,239 shad ; 36,800 lake whitefish ; 73,938 maskinonge ; 152,292 pike, perch or doré ; 233,280 tomcod ; 335,000 cod ; 496,000 smelt. In diameter the eggs vary from ¼ of an inch in the Atlantic salmon, and 3/16 of an inch in the brook trout, to 1/30

of an inch in the tomcod (*Gadus tomcod, Walb*) or 1/25 of an inch in the silver hake (*Merlucius*).

When the ripe female fish is being spawned by the hatchery operator, the eggs run freely in a stream into the pan or dish, previously rinsed in clean water, the operator gently pressing the abdomen with one hand, while with the other he holds the fish firmly in the region of the anal fin, the head of the fish being secured under the armpit, if a large fish like a salmon. A male fish is then treated in the same way, the milt flowing into the spawning pan amongst the eggs, and the eggs are stirred with a feather, thus securing fertilization. After being washed, the eggs are placed either upon black Japanned tin trays, 15 in. x 10 in. x 7/8in, perforated with small holes and holding about 2000 salmon eggs, or they are placed in glass vases 20 in. x 6 in. in diameter. The former are more suitable for salmon and trout, the jars being best for whitefish. Zinc trays are found hurtful to eggs, the officer at the Miramichi hatchery reporting in 1874 that a large number of salmon eggs were poisoned from this cause. The eggs, being alive, require abundant oxygen, hence a continuous stream of water must pass over them day and night until they hatch out. Under natural conditions river-water, of course, pours over the eggs, but fish culturists are agreed that spring-water is preferable for hatching purposes, not only because the temperature is more equable, but is purer and more free from debris and vegetable matter. In 90 to 120 or 150 days, the young fish burst from the eggs; shad, however, take only from two to five days, and cod hatch in ten to thirty days. Most of the valuable fresh-water species, like the trout and whitefish take many months. In special cases where the hatching of sturgeon and shad has been attempted as in Chautauqua Lake, N. Y., hatching boxes with double wire screen, top and bottom, have been placed in a running stream, or if containing maskinonge eggs, have been sunk at a depth of four or five feet in the lake. The fry are transferred to large tanks for periods of a few days or a few weeks, and are distributed in large cylindrical cans, nearly two feet high and twenty inches in diameter, the narrow neck of which is devised to hold ice in hot weather, in order to keep the water cool.*

*Fry are conveyed up some salmon rivers in floating crates or perforated boxes, and 25 miles of a river can be planted in a day.

The young fish carry beneath the body a small bag of food yolk, and require no other food until it is used up—a few days sufficing in some species, a few weeks in others. If possible, the fry should all be planted before the store of natural food is exhausted. In stocking lakes or rivers it is best to select inshore shallows not frequented by large fish, or rocky ridges and banks far from shore. The fish travel by rail or team for long distances without serious harm, if ice is used with care. Short distances are, however, best; indeed, Mr. Samuel Wilmot urged the establishment of small supplementary hatcheries, where the advanced eggs could be sent just before hatching, and the fry more safely distributed from them. "This system of carrying, or rather trying to carry, young fry to distant points (particularly where no speedy means of travel by railway is to be found) should be discontinued (said Mr. Wilmot in 1877), because the time almost invariably spent in fruitless journeys of this kind, could be so much better and more profitably applied at nearer points, where the safety of the young salmon in the transit could be relied upon." At times a few thousands of fry have been kept until they are four or five months old; but constant care is necessary, and a large proportion as a rule, die when the fry are kept out of their natural habitat in lakes or rivers. The feeding of fry is not easy, as the quantity and kind of food require regulation, or the results may be fatal. In 1887 eight or ten thousand young salmon were retained in a pond at the Restigouche hatchery, and were fed during the summer, "yet they did not seem to thrive well, as but few were seen in October when the pond froze over (as Mr. Alex. Mowat reported)....I have very little faith in the attempt to grow salmon fry with artificial foods, with a view of realizing any benefit from the proceeding." Last year Mr. Mowat again kept some salmon fry (about 10,000) in outside tanks with an ample stream of water passing through. Mr. Mowat is one of the best practical fish-culturists living, and this experiment was a success owing to special attention, the fry growing satisfactorily until they were nearly six months old. The food consisted of finely ground raw fish and liver; but quite as important a matter was the intelligent manipulation and care of a zealous officer in charge. The fish were well fed, yet not overfed, and kept perfectly clean, by the removal of dead and decayed matter, especially waste food

particles. Many of this batch of fingerlings measured fully three inches in length. The growth of fishes, especially young fishes, varies extremely; thus brook trout are usually two inches long when four months old; three inches when eight or nine months old, and five inches when a year old. Lake trout are six inches long at the end of the first year, and black bass at the same age are four to six inches. Salmon, when confined in ponds, are often stunted in growth, thus 3,000 salmon fry were planted in a small lake near Louisburg, Cape Breton, in 1888. In 1889 they were three or four inches long, and in 1891 (in their third year) some were caught with the fly, but were not more than eight inches in length. A similar experiment at the Restigouche Hatchery, resulted in producing young salmon, seven inches long in the third year, and ready to descend to the sea.

Discretion is not always shown in the planting of fish suited to the waters selected. Carp have been a questionable benefit, black bass in some waters have been far from a blessing, and that splendid game fish, the maskinonge, proves to be a veritable fresh-water shark in some lakes. "If planted in many of the small inland lakes (says Mr. Annin, jr., Supterintendent of N.Y. State Hatcheries) the result will be that perch, pickerel and bass fishing would be greatly damaged." If predacious fish abound, it is useless to attempt stocking with a better class fish. The fry are inevitably exterminated. In Chautauqua Lake, N.Y., the U. S. authorities wisely decided to clean out that voracious ganoid, the bill fish (*Lepidosteus*), and in two seasons over 4,000 of these useless fish were captured in seines, pounds and traps, such extermination being often necessary before stocking begins. For some years the pike perch or doré (*Lucioperca* or *Stizostedion*) were hatched at Sandwich and at Ottawa. The first batch, about one million, were hatched in 1881, but partly on account of difficulties in securing ample supplies, this species was, after ten or eleven years, no longer embraced in the Government operations. Black bass too, for a time, were hatched at Newcastle, and German carp were also included, for one or two seasons, under the mistaken idea that it would introduce "into ponds and waters (to quote Mr. S. Wilmot's report) now depleted a highly esteemed description of food fish hitherto unknown in our country." A thousand young carp were, with the late Prof. Baird's

consent, brought from Washington to Newcastle in December, 1880. Some were planted in ponds in Manitoba, but apparently without result. Pacific salmon have also been introduced into the waters of the eastern provinces. In October, 1873, 20,000 Quinnat or spring salmon eggs were generously donated to the Newcastle Hatchery by Prof. Spencer Baird ; they hatched out in December, and were planted in April following. In 1874 a second lot was sent, and in Oct., 1875, a third consignment of 80,000, (of which half were sent to Tadoussac Hatchery), and in 1876 a further batch of 40,000, and in November a further shipment of 80,000. Other lots of many thousands were kindly given by the U.S. authorities, but the results appear to be decidedly inconclusive. A fish, 15 inches long, was described by Mr. Wilmot as being captured near the Newcastle Hatchery in 1876 in the creek there and regarded as a Quinnat. "It was totally unlike the ordinary grilse or smolt of the stream, and was a male with matured milt," said Mr. Wilmot. and he added, " The first lot of California eggs was received at this place in the fall of 1874 ; this salmon must, therefore, have been two years old from the egg." In July, 1877, several more, it said, were taken. The officer in charge of the St. John River Hatchery, N. B., reported in 1885 that there were grounds for regarding the planting of Pacific salmon (Quinnat) in 1881, as a success. He reported : " Just as soon as the fishermen set their nets in spring they began to capture a strange, and to them, peculiar species of salmon with which they were unacquainted. This gave rise to enquiries and investigation, which resulted in the fact that they were California salmon, averaging some seven or eight lbs in weight. Consequently they must have been some of the identical salmon that were hatched in the Rapide des Femmes Hatchery and put into the St. John River, four years ago last March." In March and April, 1881, 35,000 young California salmon had been sent to this hatchery.

Lobster hatching had been tried in Norway by Capt. Dannevig as early as 1885, and three years later Mr. Adolph Nielson commenced operations in Newfoundland. The United States also carried an artificial lobster hatchery. A fine building, 75 feet by thirty-five feet broad, was erected at Caribou Harbour, near Pictou, N. S., and began work in 1891. A

duplex pump and twenty horse-power steam engine, draw salt water from the bay, and a wharf running out to 20 ft. depth of water, enables tugs to come alongside with supplies of lobster eggs obtained by the hatchery officers at the canneries. The eggs, it may be mentioned, are carried attached to the swimmerets in bunches, under the body of the female lobster. Ripe and well-developed eggs are selected, and are known by their paler colour as compared with the deep green or black of the newly extruded eggs. With a spoon, the hatchery operator scrapes off most of the eggs, leaving some still adhering, including some that are unavoidably crushed or burst. Having visited several of the lobster canneries, and picked out egg-bearing lobsters sufficient to give him an adquate supply—the lobsters, of course, being alive and newly brought in from the trapping grounds—the operator at once conveys the eggs in buckets on board a tug to the hatchery, places them in upright jars or vases, slightly wider than whitefish jars, where they are kept rolling about by rapidly circulating sea water until they hatch. At a temperature of 56° or 58°F, they may hatch out in 24 hours; but they frequently take fourteen or fifteen days, if the temperature is lower and the eggs are not advanced in development. At a temperature of 40° or 50° F. lobster eggs take many months for the incubation process, but so favourable are the conditions at the Bay View Hatchery, Caribou Harbour; that the annual operations are frequently over in five or six weeks in May or June. The young fry are like little active shrimps, swimming head foremost in contrast to the adult lobster, and they are so cannibalistic that they must be planted at once. They are conveyed in barrels on board a tug, each barrel having a square lid cut out, at the side which is uppermost, for aeration, and the young lobsters are lifted by scoops or dippers, and scattered in the surface waters 3 to 10 miles from land. The method of scattering them by means of a hose pipe at the stern of the tug was not successful, the delicate fry being injured. Lobster fry are never found close inshore but are pelagic in habit, and frequent the surface of the sea many miles from land. The methods in vogue at the Canadian Lobster Hatchery appear admirable, and should ensure in due time, beneficial results for the lobster fisheries along the Atlantic coast. For the sake of clearness a brief summary of some of the features of Fish-culture in

Canada may be referred to in a concluding paragraph :—

(1.) Fish of supreme commercial importance only are hatched, hence species, which are chiefly valued for sport only, are excluded.

(2.) Eggs, the hatching of which is difficult or hazardous, e. g. black bass, maskinonge, sturgeon, etc., are not included. Results, commensurate with the expenditure of public money, are problematical in the case of such species.

(3.) As far as possible all parent fish are returned alive to the water after spawning.

(4.) Salmon are impounded in tidal ponds for many months prior to the breeding period in the fall. They cease to feed on entering the mouths of rivers, and the sea water keeps them free from fungus and disease. Lake trout and whitefish, also are kept in pens or pounds for a few days before being artifically spawned.

(5.) Fry are distributed gratis on the applications being officially approved, and the government bears the expense, wholly or partially, of shipment and planting.

(6.) Lastly the fry are all practically shipped in the recently hatched condition (three days to three weeks old). This is unavoidable when vast quantities, tens of millions, are handled. Retention of the fry would involve great expense and serious loss by death, and all the applications could not be filled.

It is hardly open to dispute that the planting, year after year for over 30 years, of countless numbers of young fry of valuable economic fishes must have vastly benefited the waters of the Dominion.

The hatching of cod, mackerel and other marine fishes has not so far been attempted in Canada. The eggs and fry of these fishes are not so favourable for the methods of artificial culture, and the vast numbers produced by each spawning female (a single cod shedding 9 to 10 millions of eggs each season), the extremely delicate pelagic character of the eggs, and the futility of handling successfully the fry, are the reasons which

have deterred the government from taking up this work. If Canadian fish-culture is doing anything to keep up the supplies of fish in our salmon rivers, our great lakes and inland streams, it is doing much. By introducing western species into eastern waters and *vice versa*, it may do more, and we may therefore be content to permit the illimitable ocean, open to all the fishing fleets of the world, to be recuperated by the unassisted methods of Nature herself.

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