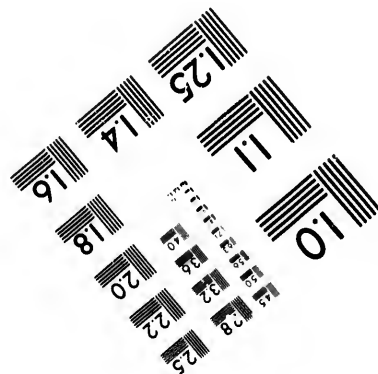
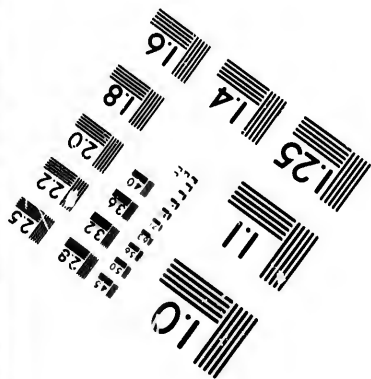
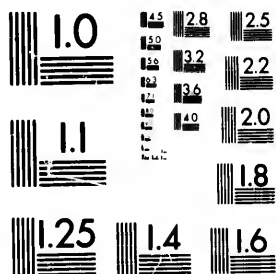


**IMAGE EVALUATION
TEST TARGET (MT-3)**



28 25
22
2

**CIHM/ICMH
Microfiche
Series.**

**CIHM/ICMH
Collection de
microfiches.**



Canadian Institute for Historical Microreproductions

Institut canadien de microreproductions historiques

1980

Technical Notes / Notes techniques

The Institute has attempted to obtain the best original copy available for filming. Physical features of this copy which may alter any of the images in the reproduction are checked below.

L'Institut a microfilmé le meilleur exemplaire qu'il lui a été possible de se procurer. Certains défauts susceptibles de nuire à la qualité de la reproduction sont notés ci-dessous.

- Coloured covers/
Couvertures de couleur
- Coloured maps/
Cartes géographiques en couleur
- Pages discoloured, stained or foxed/
Pages décolorées, tachetées ou piquées
- Tight binding (may cause shadows or distortion along interior margin)/
Reliure serré (peut causer de l'ombre ou de la distortion le long de la marge intérieure)
- Additional comments/
Commentaires supplémentaires

- Coloured pages/
Pages de couleur
- Coloured plates/
Planches en couleur
- Show through/
Transparence
- Pages damaged/
Pages endommagées

Bibliographic Notes / Notes bibliographiques

- Only edition available/
Seule édition disponible
- Bound with other material/
Relié avec d'autres documents
- Cover title missing/
Le titre de couverture manque
- Plates missing/
Des planches manquent
- Additional comments/
Commentaires supplémentaires
- Pagination incorrect/
Erreurs de pagination
- Pages missing/
Des pages manquent
- Maps missing/
Des cartes géographiques manquent

The images appearing here are the best quality possible considering the condition and legibility of the original copy and in keeping with the filming contract specifications.

Les images suivantes ont été reproduites avec le plus grand soin, compte tenu de la condition et de la netteté de l'exemplaire filmé, et en conformité avec les conditions du contrat de filmage.

The last recorded frame on each microfiche shall contain the symbol → (meaning "CONTINUED"), or the symbol ▼ (meaning "END"), whichever applies.

Un des symboles suivants apparaîtra sur la dernière image de chaque microfiche, selon le cas: le symbole → signifie "A SUIVRE", le symbole ▼ signifie "FIN".

The original copy was borrowed from, and filmed with, the kind consent of the following institution:

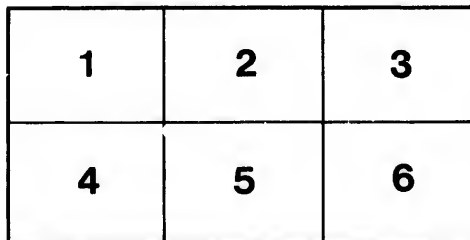
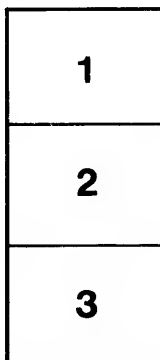
Library of the Public
Archives of Canada

L'exemplaire filmé fut reproduit grâce à la générosité de l'établissement prêteur suivant :

La bibliothèque des Archives
publiques du Canada

Maps or plates too large to be entirely included in one exposure are filmed beginning in the upper left hand corner, left to right and top to bottom, as many frames as required. The following diagrams illustrate the method:

Les cartes ou les planches trop grandes pour être reproduites en un seul cliché sont filmées à partir de l'angle supérieure gauche, de gauche à droite et de haut en bas, en prenant le nombre d'images nécessaire. Le diagramme suivant illustre la méthode :



RISING OF THE LAND AROUND HUDSON BAY.

BY

ROBERT BELL.

FROM THE SMITHSONIAN REPORT FOR 1897, PAGES 359-367.

WASHINGTON:
GOVERNMENT PRINTING OFFICE,
1898.

a
E
m
in
e
ra
th
d
S
h
R
m
I,

ac
ru
w
is
Si
sh
w
sh
th
ap
be
sh

th
va
my
Ab

RISING OF THE LAND AROUND HUDSON BAY.¹

By ROBERT BELL,
Of the Geological Survey of Canada.

In the Provinces of Ontario and Quebec it has been found from actual levelings by Gilbert, Spencer, and Upham that the old shore lines are not perfectly horizontal, but that they slope upward in a northeasterly direction at rates varying in different regions from a few inches to a foot and even 2 feet per mile. If this upward slope were continued in the same direction to the northeastern extremity of Labrador, 1,300 miles from Lake Huron, the increase in the elevation might there amount to 1,000 or 2,000 feet. It is scarcely probable that the differential elevation is constant and regular for such a great distance. Still, it is a fact that well-preserved shore lines are to be seen at great heights in the northern parts of Labrador. In my Geological Survey Report for 1884 I have mentioned ancient beaches at Nachvak, 140 miles south of Hudson Strait, which have an estimated altitude of 1,500 feet above the sea.

The two sides of Hudson Bay present very different physical characters. The eastern is formed mostly of crystalline rocks, and, as a rule, is more or less elevated, with a broken surface sloping somewhat rapidly westward or toward the bay; while the western side is mostly very low and much of it is underlaid by nearly horizontal Silurian and Devonian strata. These low shores are accompanied by shallow water extending far to seaward. The head of James Bay, which forms the southern prolongation of Hudson Bay, is extremely shallow, but the various rivers which flow into it have cut channels through the soft shallows, and by means of these the land may be approached with seagoing vessels. The whole of Hudson Bay may be said to be shallow in proportion to its great area, as the soundings show that it does not average more than 70 fathoms in depth.

The shores of the bay everywhere afford abundant evidence that there has been a comparatively rapid rise in the land and that the elevation is still going on. I have mentioned numerous proofs of this in my various official reports on the geology of these regions from 1875

¹ Read before the Geological Society of America, Philadelphia, December 27, 1895. Abstract as printed in *American Journal of Science*, fourth series, Vol. I, March, 1896.

to 1886, and I shall now recall a few of those and give fresh ones in addition, some of which came to my knowledge on a journey to the bay during the past summer. It is well known to those who have paid any attention to the subject that since the establishment of the posts of the Hudson Bay Company in the mouths of the rivers around the bay, two hundred years ago, there has been an ever-increasing difficulty in reaching these establishments from the sea.

On the eastern side the most striking evidence of the rising of the land is afforded by the numerous well-preserved and conspicuous terraces cut in the till and other deposits. Near the sea these may be seen at various heights, up to about 300 feet, but above this elevation the scarcity of soft material out of which terraces might be excavated renders this kind of evidence less apparent than it might otherwise be at higher levels.

On this side of the bay one of the best evidences that the elevation of the land is still going on is furnished by the long lines of driftwood which one sees in many places far above the reach of the highest tides.

The old beaches, on which this wood is plainly seen, occur at various levels up to about 30 feet above high tide, but the remains of rotten wood may be detected in some localities up to nearly 50 feet above which it has disappeared from the ancient shores by long exposure to the weather. This driftwood consists principally of spruce, but a little white cedar and other kinds, which have been brought down by the rivers, are also mixed with it. The bark having been worn off by the action of the waves while the trunks were still fresh has tended to their preservation. Owing principally to the salt water and the cold climate, wood endures for an incredibly long time in exposed situations in this region wherever it has an opportunity of drying quickly after rain. Some of the wood which may still be seen upon the higher levels may be upward of six hundred years old.

It has been suggested that all this driftwood along hundreds of miles of coast may have been thrown up by some extraordinarily high tide. But there are many reasons why this is quite unlikely. It seems impossible that any modern tide could rise to such a great height and deposit so much wood at different levels all at once and in such even lines, following all the sinuosities of more than one of the raised beaches. The suppositions extraordinary tide would necessarily be of brief duration, and would be accompanied by a tremendous gale blowing upon the coast. This would have the effect of throwing the wood in confused heaps and only into situations favorable for catching it, such as angles of the shore. But instead of this we find it at different levels laid longitudinally all along, as if accumulated by slow degrees with moderate winds from every quarter. The fact that the wood is freshest along the lower lines and becomes progressively more decayed as we ascend, and that finally only traces remain on the higher levels, shows that it must have been stranded from time to time

as the land was rising above the sea, and we are forced to adopt this obvious view of the case.

In support of the paroxysmal tide theory, it is related that once during a northern gale the tide was forced as high as the front gate in the palisaded inclosure at Rupert House, near the head of James Bay, and it is added that this would be equivalent to a height of about 30 feet. When at Rupert House last summer, I could hear no authentic account of such an extraordinary rise in the water, and, besides, the gate referred to did not appear to be more than 15 feet above the sea level. But even if such a great rise in the water had once occurred at this place, it would prove nothing in regard to the raised beaches on the long straight shore out on the open sea. Hudson Bay is about 1,000 miles long and its outline is funnel-shaped, with James Bay representing the contracted extremity. Rupert House is situated near the end of this narrow continuation, so that just here we should expect very high water with a spring tide and northern gales driving the sea in from the broad expanse outside and heaping it up at the extremity of the constantly narrowing termination.

The gravel terraces seen at various elevations around the coves and upon the thousands of small islands along the east coast of James Bay are remarkably sharp and well preserved and almost as fresh-looking as if they had been formed but yesterday. They are generally bare of trees or bushes and the yet smooth surface pebbles are only partially covered by lichens. Similar terraces may be seen farther north on this coast and in Hudson Strait, wherever material exists out of which they may be formed. On Marble Island the raised beaches are very plainly visible on account of the whiteness of their smooth quartzite shingle.

On the west side of Hudson Bay the land is generally too low to admit of the relatively higher sea levels of former times having been recorded in the shape of terraces near the present shore line, but if we go back into the woods we shall find unmistakable evidence of the existence of such higher levels at comparatively recent periods. These consist of long, low ridges of drifted materials, such as we see in a fresher state at the present high-tide mark. They are made up of driftwood and other vegetable débris in a completely decayed condition, covered by moss and having trees and shrubs growing upon them. In some places we may still trace the forms of the larger trunks which had been cast ashore by the waves at high tide. Between these ridges and the present shore there is a thick growth of the coniferous forest and the ground is carpeted with moss, over which the tide has never passed. Examples of these low ridges may be seen near the head of tide water at the mouth of Nelson River, at Attawapishkat River, and in places between the latter and Albany River.

To the west and southwest of James Bay the fill, covering the nearly flat Silurian and Devonian rocks, is generally overspread by stratified clays. Marine shells are found in these up to an elevation of 400 to

500 feet, but on the eastern side of the bay no fossils have yet been detected at such high levels, owing perhaps to the scarcity there of marine deposits and to the fact that but little search has yet been made for them. In the sandy deposits among the hills about 20 miles south of Cape Woostenholme I saw abundance of *Saricara rugosa* and *Tellina granulatica*, with smaller numbers of a few other species, at heights varying from the sea level up to about 200 feet; and last summer I found brackish water varieties of a number of the commoner species of our northern marine shells up to 70 feet above the sea in the clay banks along the lower portion of the Noddawai River.

Around the head of James Bay and up its western side the encroachment of the outer lines of the forest upon the wide alluvial flats which extend all along these shores and are constantly broadening toward the sea is good evidence that a rising of the land is now going on. The existing condition in this part of the bay is well described by Mr. A. P. Low in speaking of Agoomski Island. On page 24, J. Geol. Survey Report for 1887, he says:

"The island closely resembles the adjoining mainland in physical character, being very low and swampy. The shore line above high-water mark is made up of muddy flats covered in part with grasses and sedges, followed farther inland by thick growths of small willows, these in turn giving place to small black spruce and tamarack as slightly higher ground is reached. The line of these trees is often over 2 miles inland from high-water mark, itself a long distance from the sea at low water."

No living mollusks are to be found in James Bay, except perhaps in the northern part, owing probably to the muddy and brackish nature of the water, but abundance of the dead shells of a considerable number of kinds are washed out of the clays forming the present shores. Some of these belong to moderately deep-water species and are well preserved, retaining the epidermis. This, of course, shows a recent elevation of the sea bottom.

Richmond Gulf, on the eastern side, is separated from the main bay by a high bar of stratified rocks, which strike with its length and dip westward or toward the open sea. This bar is cut through by several gaps, all resembling one another, except in their heights above the sea, and all bearing evidence of their having been well-worn channels of communication at more or less remote times according to the greater or less elevation of their beds above the sea. Only one narrow passage now remains open or low enough to admit the water, but two others are as yet only slightly raised above the tides.

Some of the aboriginal geographical names around the head of James Bay are significant of considerable changes in the topography since these shores became inhabited by the natives who still occupy them. The large peninsula between Hannah and Rupert bays is called *Ministik-oo-watum*, which means wooded island with a cove or hole in it, *ministik* being the Cree for a wooded island and *watum* for a cove or

hole,
penin
grou
strip
The
Fort
name
(Cort
main
first
stant
of th
beco
large
soft
Th
vieu
geese
venie
upon
Th
Alba
parti
long
many
const
from
On
grad
then
falls
indie
On
foun
eleva
on t
stre
weir
Diga
and
estim
A
adv
Huc
coas
be p
leve

hole. The heads of the channels, which now run in behind the present peninsula from the opposite sides, are separated by a strip of low ground, some 10 miles long, covered by bushes. Midway across this strip the elevation is estimated to be about 15 feet above high tide. The most prominent point on the coast between Moose Factory and Fort Albany is now called "Cockispenny" by the whites, but the Cree name is Ka-ka-ki-sippin-a-wayo Minis, or Island where the Crow-duck (Cormorant) lays eggs. Since this island has been connected with the mainland, bushes have taken the place of the grasses and sedges which first grew upon the low ground between them, and the former are constantly acquiring a stronger growth. Many years ago the winter trail of the coast passed over the neck of this peninsula, but now it has become necessary to go outside of it, because the bushes have grown so large that they catch the snow which, in such situations, remains too soft for dog teams and snow shoes.

The salt marshes along the west coast of James Bay and also in the vicinity of York Factory, which used to attract vast numbers of wild geese and ducks, have been gradually drying up, much to the inconvenience of the Hudson Bay Company's people, who depended largely upon them for food.

The character of the lower portions of such rivers as the Moose, Albany, and Attawapishkat shows a recession of the sea. This is particularly observable in the lower 30 miles of the Moose, where very long and narrow or ribbon-like islands run parallel to one another for many miles. The process of their formation appears to have been a constant drawing out of their lower extremities as the sea receded from them, just as the lowest islands of the present day are growing.

On the east main coast, where the land is comparatively high, the grade of the rivers is rapid as they approach the bay, and in some of them, as the Nastapoka and the Langlands, there are perpendicular falls of about 100 feet almost directly into the sea. This condition indicates recent elevation.

One of the best evidences of the modern rising of the land is to be found in the beach dwellings of the Eskimo, which may be seen at all elevations up to about 70 feet. In summer these people generally camp on the shore, and their favorite locations are at the mouths of small streams into which the sea trout run at high tide. Here they construct weirs of stones, which impound the fish when the tide retires. On Outer Digges Island, I have found these fish traps and the rings of stones and other structures marking their old camping places up to a height estimated at 70 feet.

Among the historical evidences bearing upon this question since the advent of the white man may be mentioned the fact that in 1610 Henry Hudson, the navigator, wintered in a bay full of islands on the east coast south of latitude 53°. None of the bays in this region would now be possible for this purpose, showing that a considerable change in the level of the sea has taken place in less than three hundred years.

In 1674 Charles Bayley, then local governor for the Hudson Bay Company, sailed through in a sloop between Agoonski Island and the main west shore of James Bay. It would now be impossible to pass here in a seagoing vessel of any kind. In 1886 I found it difficult to get through in bark canoes, drawing only a few inches of water. The shoaling is not due to a silting up, since the almost dry bottom consists of a level surface of fill with bowlders scattered thickly over it.

From 1675 to 1685 the Hudson Bay Company's establishment in the mouth of Moose River was upon Hayes Island, which, it is to be presumed, was selected for convenience of landing goods from their vessels and shipping out their returns. This island is now unapproachable except by canoes and small boats. For more than two hundred years the factory¹ has stood upon Moose Island, the next below Hayes Island. The annual ship from England anchors in the channel cut through the sands off the mouth of Moose River. On account of the risk of rough water it is necessary to discharge the cargo by schooners. Within the memory of living men these schooners could ascend to a wharf built opposite the large storehouse of the factory. But for many years the same schooners have been unable to ascend all the way, and the cargo requires to be transferred into scows, which complete the trip to the wharf: and the distance to which the schooners can ascend is constantly diminishing. In the beginning of the present century Princess Island, a narrow, bushy strip immediately in front of the factory, was separated by a channel with a good depth of water at the lowest tides. Last autumn I saw it quite dry on several occasions during ebb tide. It is well known to everyone who has lived at this post in the present generation that every now and then a new "hump" will appear in the bed of the river and become permanent, growing higher and higher, eventually escaping submergence at most tides and at length becoming covered with grass and then with bushes. Some islands which were covered only with bushes forty or fifty years ago now support a growth of young trees. The small one on the west side of Middleboro, below Moose Island, is an example of this, and the appearance of the trees upon it is within the memory of Mr. Broughton, the gentleman now in charge of Moose Factory. Middleton Island, between the mouths of Rupert and Noddawai rivers, lies close to the east shore of Rupert Bay. Up to a few years ago canoes and boats could pass at high tide through the long, narrow, grassy channel behind this island, but last autumn I found it impossible to do so with my canoes, and we were obliged, at great inconvenience, to go round outside.

Two hundred years ago the ships of the Hudson Bay Company appear to have had no difficulty in entering the mouths of various rivers on the Eastmain Coast, which can not now be used as harbors. In old times the principal post of the company on that coast was in the mouth of Eastmain River, which had no doubt been chosen because it afforded

¹ Factory, a residence of a factor or agent.

a good harbor. It is only a few years since the mouth of Little Whale River, several hundred miles farther north, had to be abandoned as a harbor on account of the increasing shallowness of the water.

At York Factory there is a "ship hole" in the channel of Hayes River, directly in front of the storehouse. The seagoing vessels of light draft employed in the Hudson Bay Company's trade have been accustomed to anchor in this hole, and formerly they remained afloat at all stages of the tide, but of late years vessels drawing even less than those of former times have begun to "take the ground" at low water. In objection to the belief that the land is rising it may be said this may be due to a silting up of the hole, but on examining the material brought up on the flukes of the anchors I found it to consist of light-colored stiff boulder clay or till.

In 1782, after the French Admiral Lepeyrouse had destroyed Fort Prince of Wales at the mouth of Churchill River, he landed with cannon on the southeast side of Nelson River, and, hauling them across the point between it and Hayes River, captured York Factory. Two ships belonging to the Hudson Bay Company which were then lying in Hayes River, laden with valuable cargoes, escaped under cover of the darkness of the following night and got safely to England. At the present time it is only possible for a seagoing vessel to get out from this river at the top of high water with favorable wind and careful piloting in daylight. To say nothing of the difficulty caused by the darkness, it is unlikely that all the other conditions now necessary to enable a vessel to leave the river conspired to aid the escape of these ships. It is much more reasonable to believe that the water was deeper then than it is now. The landing of Lepeyrouse with his guns on the shore of Nelson River abreast of York Factory was a feat the like of which could not be accomplished at the present day, owing to the extreme shallowness of the water.

The present Fort Churchill, or "New Fort," as it is still called, was built in 1782 on the west side of the river, about $1\frac{1}{2}$ miles above Fort Prince of Wales, as soon as the French had retired after destroying the latter establishment. The residents now suffer much inconvenience on account of the continued shoaling of the water, and they have been obliged to lengthen out their "lanneh" or long landing trestle from time to time in order to be able to reach the outer end of it with their coast boats.

Off the western side of the lagoon, within the mouth of Churchill River, is Sloops Cove, a small elliptical pond connecting with the lagoon by a very narrow entrance, through which the water barely passes at high tide. On the arkose rocks beside this little cove many inscriptions have been cut and some ring bolts have been fastened for mooring vessels, all of which indicate that the cove was used for wintering ships in old times. Indeed, it is known that the *Furnace* and the *Discorery*, two small ships commanded by Captain Middleton, passed the

winter of 1741-42 in this cove. I have examined the place on various occasions and have copied most of the sketches and inscriptions on the rocks, and it always appeared to me that the conditions which we observe indicate a rise in the land since the last ship wintered there. At the present time the tide does not rise high enough to allow of the passage into it of crafts larger than ordinary rowboats. No seagoing vessel could now enter it, which would indicate an elevation nearly equal to the draft of the ships formerly frequenting it. It would be a boon to the agents of the Hudson Bay Company at Churchill if they could now winter their small schooner in this cove instead of being obliged to send her every autumn to winter at York Factory. The captain who commands her happens to be the person now in charge of the company's post at Churchill, and both he and his crew are obliged to walk back 150 miles through the mud from York Factory after leaving their vessel there in the autumn, and to walk the same distance again to bring her back in the spring. Mr. J. B. Tyrrell visited Sloops Cove in the autumn of 1893, and in a paper published in the Geological Magazine for August, 1894, says he thinks the land is here in a state of equilibrium. Two inscriptions which he saw on the rocks, namely, "May 25 and May 27, 1753," were about 7 feet above the present high tide, and he thinks these were cut by men standing on the ice. This, however, does not prove much, for the men were quite as likely to have sat as stood while engraving these inscriptions. As the tide still enters the cove and keeps it full of water the average relative level of its ice to the rocks surrounding it may not have differed much from what it is now. When I visited Fort Prince of Wales in 1879 oak planks brought from England while the fort was still occupied, as well as timbers of native wood, all charred by Lepeyrouse's fire, were found stranded far out of reach of the present tides and still in perfect preservation. On the occasion referred to I met at the "New Fort" children of some of the people who were living at the "Old Fort" when it was captured by the French, and from them some information could be obtained as to the conditions at that time. We have, besides, the description and illustrations in the book by Samuel Hearne, who was then in charge of the place. Any light which these accounts may throw on the state of matters then as compared with the present time points in the direction of some elevation having taken place.

Among the photographs which I took around Fort Prince of Wales in 1879 is one which shows strips of dry land grasses alternating with little parallel ridges of gravel thrown up by the waves and now above the highest tide mark, but below the level of the spot which was pointed out to me as the landing place of Lepeyrouse. The ground on which the fort stands was an island during high tide at the time the place was occupied, and a bridge was thrown across the narrowest part of the little separating channel to connect the island with the mainland. This channel is now entirely dry.

If anything further were wanting to show that an elevation of the land is now going on in this region we have some direct personal evidence in the lifetime of the witness himself in support of the facts already cited. About twenty years ago a very aged Indian, who was said to have "seen more than a hundred winters," and who was quietly passing the last years of his extraordinarily long life at Norway House, told me in presence of the factor, Mr. Roderick Ross, and the other gentlemen of that establishment that he had, when a boy, witnessed the landing of Lepeyrouse and the destruction of Fort Prince of Wales. He gave graphic details of every circumstance, which agreed perfectly with Lepeyrouse's own account, and he answered all my questions on other points entirely satisfactorily and without a moment's hesitation. Among other things, he mentioned that the spot where the Frenchmen's boats landed was quite close to that portion of the western wall which they undermined and blew up with gunpowder. He said that when all was ready they laid a "rope" (train) of gunpowder across the beach and, setting fire to the end of it, ran off to a safe distance to witness the effect. It is now a considerable distance from this spot to the nearest point of water at high tide.

The proofs of the rising of the land around Hudson Bay in post-glacial times would be admitted by any geologist, and the question of the continuance of the movement at the present time is, I think, answered in the affirmative by the actual general shoaling of the water which is going on, and the encroachment of the land on all sides, some proofs of which have been given in the foregoing pages. All the facts which have been mentioned (and many more might be added) point in the same direction, while there appears to be no evidence of a contrary character. The officers of the Hudson Bay Company are an intelligent set of men, and their universal opinion, based upon lifetimes of observation, is that the land all around the bay is rising. The following is part of a letter recently received from Mr. Joseph Fortescue, lately a chief factor in the Hudson Bay Company, in answer to my request for his opinion on this subject:

"Regarding the rising of the shores of Hudson Bay I have no doubt whatever. When I was at York Factory I heard several Indians say that the sea or tide had retired 2 miles from places they remembered when they were young, and my own observations during twenty years there would lead me to entertain the same opinion. When I revisited Moose Factory, after nearly forty years' absence, I found a great change in the appearance of the coast and river. Channels which were navigable at all times of the tide formerly could now only be used at high water."

