

# REMARKS ON THE TIDES AND DRIFTWOOD STRAND LINES ALONG THE EAST COAST OF JAMES BAY

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ON 24 June 1950 A. H. Macpherson and I left Moosonee by canoe and, after stops of over two weeks at Moar and Paul bays, we arrived at Long Island on August 8. We began the return journey three days later, made several stops of a few days each at various places on the east coast of James Bay, and arrived back in the Moose River on September 7. The primary purpose of the trip was a study of the birds and mammals along the northern parts of the coast but, whenever possible, we set up a tide scale and took readings as frequently as our other work permitted.

Normally, readings were taken at irregular intervals of half an hour to four hours from about 0700 to 2100 EST. Owing to our other work it was not practicable to take night readings. Lack of these is not of great consequence north of the Paint-hills Islands, as the tide there is of the synodic type with relatively small diurnal inequalities. South of the Paint-hills Islands, however, and particularly in the Moar Bay area, where the tide appears to be primarily declinational with a marked diurnal inequality and a small range, apparently much affected by the wind, the height and time of the night tides is doubtful.

Fig. 1 shows Eastern Standard Time and the height in feet of high and low water at all places (except Moar Bay) where readings were taken. These figures are derived graphically from the tidal curves, and are given only when these could be drawn with reasonable exactness for the periods of high and low water. The high water lunitidal interval in this table is the interval between the moon's transit at Greenwich and the Greenwich mean time of high tide.

The longest series of readings north of the Paint-hills Islands was taken at Paul Bay. There, the mean Greenwich lunitidal interval, derived graphically from a plot of the semi-diurnal records, was about 40 minutes, with a maximum interval a day or two after full and change, and a minimum three or four days before full and change. The lunitidal intervals of seven high tide readings obtained at the Roggan River fall closely along the projected curve of the Paul Bay intervals, and there appears therefore to be no difference in the time of high water at these two places. Our three high water readings at Long Island suggest that here also the average lunitidal interval is about the same or a shade smaller than at Paul Bay. South of Paul Bay, high water appears to be slightly later since the lunitidal intervals at Stromness Harbour, Walrus Peninsula, and Pointe au Huard are all about 20 minutes larger than those for

Date	Moon	GMT	High Tide			Low Tide						
			EST	GLTI	Feet	EST	GLTI	Feet	EST	Feet	EST	Feet
July 13.....	N											
July 15.....	●	0505										
<b>Two miles north of Pointe au Huard</b>												
July 16.....												2.0*
July 17.....			1040	1:34	4.9							
<b>Paul Bay (near Piagochiwi River)</b>												
July 20.....	E											
July 22.....	D	1050				1340	0:40	6.9			2000	1.5
July 23.....						1420	0:25	7.1	0810	1.5	2040	1.7
July 24.....						1510	0:20	6.9	0920	1.6		
July 25.....	P					1615	0:20	6.9	0950	1.8		
July 26.....	S					1710	0:10	7.2	1115	1.9		
July 27.....						1820	0:20	7.5				
July 28.....			0720	0:50	7.3	1925	0:25	8.0			1330	2.6
July 29.....	○	0417	0835	1:05	7.9	2045	0:50	8.2			1440	2.7
July 30.....			0920	1:00	7.8	2140	0:55	8.2			1530	2.2
July 31.....			1010	1:00	7.6						1620	1.7
Aug. 2.....	E		1140	1:10	7.0						1740	0.9
Aug. 3.....						1220	1:05	7.0		0.6	1810	0.6
Aug. 5.....	A	1956				1325	0:50	6.5		1.2	1930	1.3
Aug. 6.....						1400	0:40	6.8	0740	1.4		
<b>Long Island</b>												
Aug. 8.....						1505	0:05	4.5				
Aug. 9.....	N					1610	0:15	4.5	1010	1.4		
Aug. 10.....					4.6	1720	0:30	3.8	1130	0.8		
<b>Roggan River</b>												
Aug. 11.....						1830	0:50					
Aug. 12.....			0700	0:50		1925	0:50	5.4			1330	1.3
Aug. 13.....	●	1648	0810	1:10	4.8						1445	0.9
Aug. 14.....			0900	1:10	5.0						1500	-0.2
Aug. 15.....			0935	1:00	5.8						1530	0.3
Aug. 16.....	E		0950	0:30	6.6							
<b>Stromness Harbour</b>												
Aug. 20.....	P											
Aug. 22.....	S											
Aug. 25.....						1820	0:35	6.1			1230	2.3
Aug. 26.....			0735	1:25	5.0	1940	1:05	4.8			1330	0.6
<b>Southeast side of Walrus Peninsula</b>												
Aug. 27.....	○	1451				2040	1:20	5.9			1410	0.9
Aug. 28.....			0910	1:25	5.7						1530	1.1
<b>Paint-hills Islands (south side)</b>												
Aug. 29.....	E										1930	1.0
Aug. 30.....						1300	3:50	1.9	0740	0.2	2030	0.7
Aug. 31.....						1330	3:40	2.5	0800	0.7	2030	1.7
Sept. 1.....					3.3	1330	2:60	2.6	0900	1.3		
<b>Spit Island</b>												
Sept. 3.....	A					1705	5:00	2.5				
Sept. 4.....	☾	1353	0700	6:35	2.2	1730	4:40	2.3			1210	0.6
<b>Loon Point</b>												
Sept. 5.....						1940	5:55	2.4				
Sept. 6.....	N		0920	7:10	3.6			4.2+			1355	1.8

\*approximately.

**Fig. 1.** Height of high and low water at places in east James Bay derived from the tidal curves. Note: the times given under GMT are the times of new, half, and full moon respectively. All other times are to the nearest 5-minute interval. The heights given for high and low water are the original readings taken on the tide scale which was necessarily set at a different datum at each place.

GMT = Greenwich Mean Time  
 EST = Eastern Standard Time  
 GLTI = Greenwich Lunitidal Interval

N = Maximum North Declination  
 S = Maximum South Declination  
 E = Moon on Equator (Declination 0°)

P = Perigee  
 A = Apogee

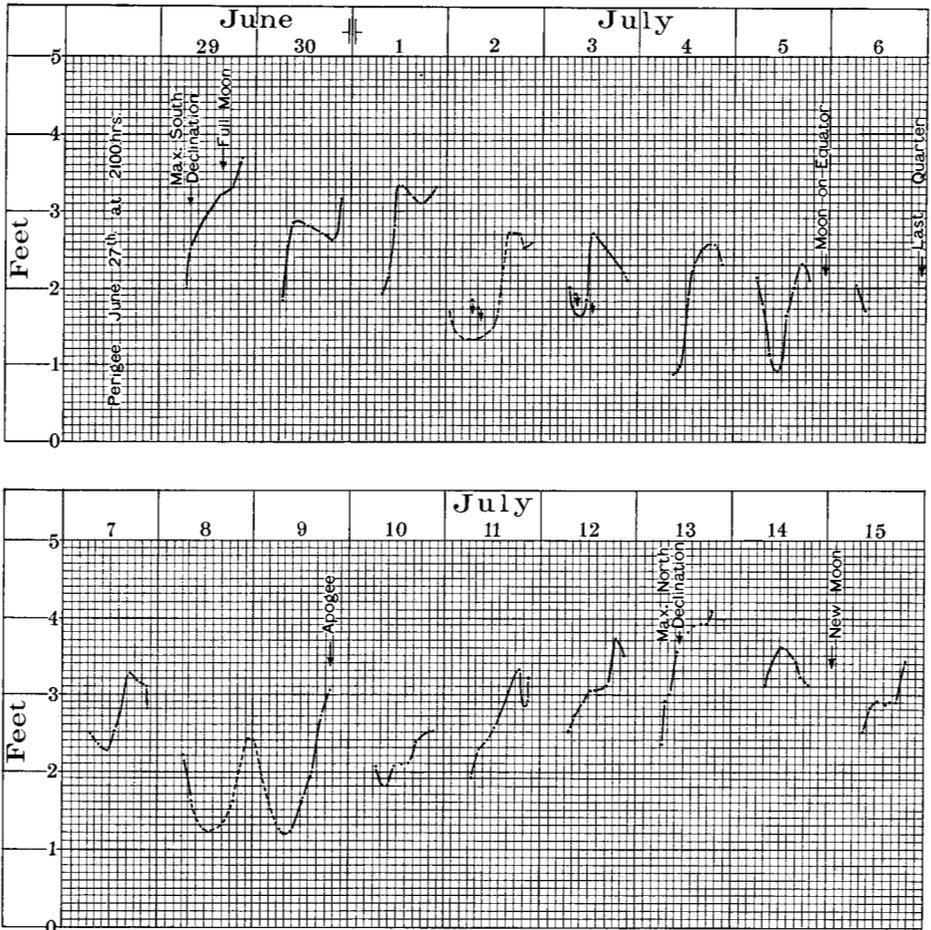


Fig. 2. Plot of tide readings taken at the southern end of Moar Bay to the east of Sheppard Island. The dots indicate scale readings. The dots on July 2 and 3 with arrows pointing downwards indicate readings taken after the level of the water outside the small bay where the scale was situated had dropped below a boulder bar at the entrance to the bay. After July 3 a second scale was set up in the outer bay and used for low water readings. At midday on July 13 the scale was moved to Sheppard Island, about half a mile distant. The break shown in the graph at this time indicates the estimated tidal rise during the hour and a quarter which elapsed while the scale was being moved.

the same period of the lunar phase at Paul Bay. A longer series of readings at these places might negate this.

The change from the synodic tide of northeastern James Bay to the declinational type at Moar Bay probably occurs at the Paint-hills Islands, which, with the Solomons Temple group of islands and the shoals which lie between, might be expected to interfere with the even progress of the tidal undulation.<sup>1</sup> The sudden increase of the lunital interval and the apparent decrease in the range in the short distance between Pointe au Huard and the Paint-hills Islands can be seen in Fig. 1. The diurnal inequality of the tides at Moar Bay during the periods of greatest lunar declination is clearly shown

<sup>1</sup>We observed strong currents among both these groups of islands. The only other places on the east coast of James Bay where we noticed strong currents were Cape Jones and the strait between our camp at the south end of Moar Bay and the nearby island.



in Fig. 2. It will also be noted that low water usually occurred in the morning, and high water in the afternoon or evening. One exception was July 8, when it remained low all day. Obviously winds in different parts of the bay would have a relatively large effect on a tide with so small a range. Also, we were camped in a small bay with a narrow entrance lying behind a moderate-sized island, and this may have caused some local irregularities. The diurnal inequality of the Paint-hills Islands tide was not very apparent during our

three days' stop, but its affinity to the Moar Bay tide is indicated by its apparent tendency to be high at approximately the same time on successive days. The lunital interval here and at the Paint-hills Islands is therefore of no value except to show the sudden change in tide type.

Our stops at Spit Island and Loon Point were too brief to discover the type of tide at these places. Diurnal inequality of range was not obvious, but the morning high water was distinctly later than the afternoon. On September 4 the morning high water at Spit Island was almost an hour later, and the evening almost an hour earlier than the corresponding highs at Charlton Island ('Tide tables', 1949). On September 5 the Loon Point evening high water was a little later, and the morning over an hour later than the corresponding Charlton Island highs.

It has previously been shown from approximate observations (Manning, 1950) that the tidal undulation travels southeast from Churchill along the southern coast of Hudson Bay, arrives at Cape Henrietta Maria about  $8\frac{1}{2}$  hours later, and then swings down the west coast of James Bay, reaching Houston Point (Akimiski Island) about 12 hours after passing Churchill. Our east James Bay readings indicate that what is probably the same tidal wave reaches Paul Bay and the Roggan River at approximately the same time as it does Houston Point, while to the north and south it may be a few minutes earlier and later respectively.<sup>1</sup> Rough observations of the time of high water at several places on the west coast of Akimiski Island were made in 1947 (Manning, 1950). The current 'Tide tables' (1949) provide a method of determining high and low water at Charlton Island, Stag Island, and Rupert House. The 1931 'Tide tables' (1930) also gives similar data for the Strutton Islands, where the rise is  $5\frac{1}{2}$  feet at springs, and 4 feet at neaps, and high and low water may be obtained by adding 2 hr. 35 min. and 2 hr. 40 min. respectively to the relevant figures for Harwich ('Admiralty tide tables', 1949). Generalizing roughly from these data and those given on the Canadian Hydrographic Service Charts Nos. 5413, 5416, and 5000, it appears that high water at Charlton Island and the Strutton Islands occurs at almost the same time as at Shippans Island. On the mainland coast near Spit Island it averages the same as at these islands, but becomes progressively later towards the entrance to Rupert Bay, where, at Stag Island, it is about one hour later than at Shippans Island, and at Rupert House 2 hours later.

Obviously, the figures given in Fig. 1 for the height of high and low water only provide a comparable range for a few stations, since at most places the period of observation covers only one phase of the moon. It is apparent, however, that the greatest range along the east coast of James Bay is near Paul Bay and the smallest near Moar Bay (Fig. 2), even if at the latter place only the highest and lowest tides of the day are considered. The small ranges obtained at Spit Island and Loon Point may have been due in part to

<sup>1</sup>'Tide tables' (1949) give the time of high water at Fort George as 1 hr. 25 min. later than Churchill, which would be 13 hr. 50 min. later than the preceding high water. This information is based on partial daytime scale readings at the Hudson's Bay Company's post for 13 days in 1935, and 24 days in 1936 (R. B. Lee, Chief, Tidal and Current Section, in letter).

meteorological conditions, since for adjacent stations at Charlton and Stag islands there is a spring rise of 7 and 9 feet respectively, and a neap rise of  $5\frac{1}{2}$  and  $7\frac{1}{4}$  feet respectively ('Tide tables', 1949). On August 4 the range at Fort George (Hudson's Bay Company's post) was about 4 feet. It may be noted in Fig. 1 that while the height of high water at Paul Bay increased towards full moon, the height of low water also increased, so that during the time of our observations there was no appreciable increase in the range at spring tides. It will also be seen that the highest daytime tides occurred before 1100 or after 1800 hours, and the lowest daytime tides a shade earlier, both in the morning and evening.

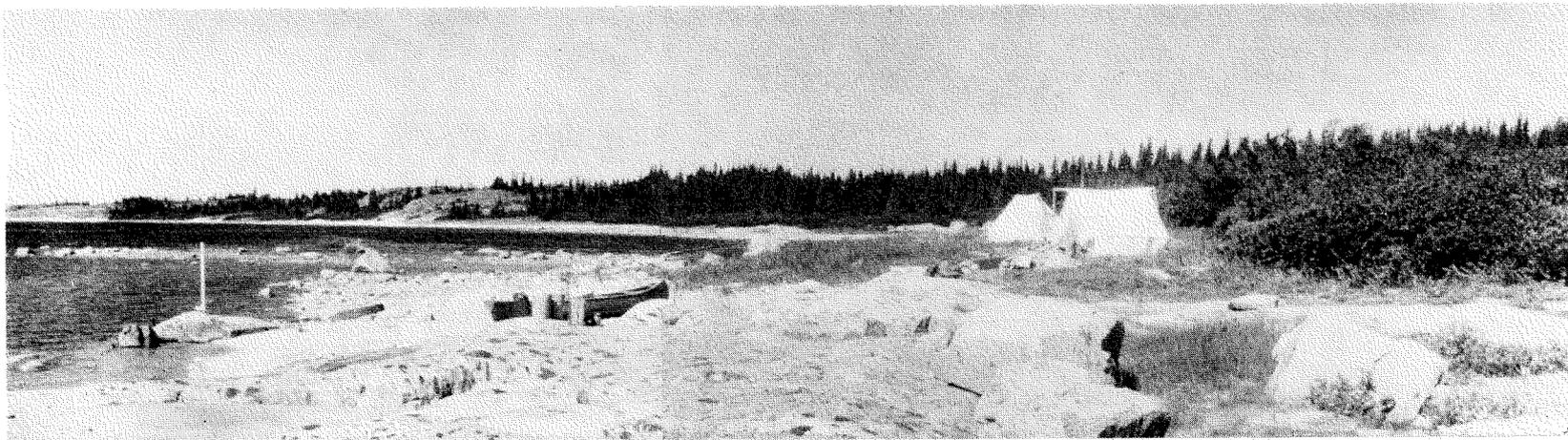
#### DRIFTWOOD STRAND LINES AND THE UNUSUALLY HIGH TIDE OF OCTOBER 1949

Several travellers (Manning, 1950) have remarked on the effect of the wind on the James Bay tides, but actual measurements of exceptionally high tides are lacking. Last summer (1950) Mr. A. Thorburn, Hudson's Bay Company's post manager at Fort George, told me that one Sunday morning about mid-October 1949,<sup>1</sup> a northwest gale was accompanied by a tide which the Indians considered the highest in living memory. Mr. Lutitt, who was born at Fort George about seventy years ago and who has resided there and at Great Whale River all his life, was also unable to recall any tide of equal height. This exceptional tide was also observed at other places along the east coast of James Bay. At Old Factory River post, where there is very little normal rise and fall, the water stayed high for most of Saturday and Sunday, and at Eastmain it was said to have risen to within about a foot of the top of the wharf. In 1950 the strand line left by this tide was still easily distinguishable from older strand lines by the dead grass, sticks, and other comparatively ephemeral debris. It could be seen wherever conditions were suitable from Long Island to Loon Point. At Paul Bay, the Paint-hills Islands, and Spit Island, all sheltered from the direct effect of a northwest wind, it was found to be  $5\frac{1}{2}$  feet, 6 feet, and  $6\frac{1}{2}$  feet respectively above the height of normal summer spring tides. At Paul Bay it was  $3\frac{1}{2}$  feet above the edge of the lower limit of the main growth of strand-wheat, *Elymus arenarius*, and approximately the same height had been reached at a number of other places. Where the shore was bordered by alder, the 1949 strand line usually lay half a foot to a foot vertically above the lower limit of the alder, and up to three or four yards horizontally within the alder. In places exposed to the full force

<sup>1</sup>Mr. Thorburn thought this high tide occurred on October 16, but that week-end was a period of neap tides, and the meteorological synoptic chart shows that winds were light throughout James Bay and eastern Hudson Bay and Strait. The actual date of this high tide was almost certainly the following Sunday, October 23, which coincided with spring tides and meteorological conditions which were clearly ideal for driving water through Hudson Strait into Hudson Bay and thence to James Bay. At 1930 EST on Saturday, October 22, the pressure was about 976 millibars in the James Bay area, and a depression which had passed north up James Bay was centred over the Belcher Islands. The following winds were recorded in the area: Moosonee, WNW, force 7; Coral Harbour, N, force 11; Nottingham Island, E, force 4; Cape Hopes Advance, SE, force 8; Resolution Island, SE, force 7. I am indebted to Mr. B. W. Boville of the Department of Transport for this information.



Driftwood strand lines on the north shore of Sheppard Island, looking east, 8 July 1950. The largest pile was left by the high tide of October 1949.



Upper tide scale and camp at Paul Bay, looking west. Photographs taken near high tide on 31 July 1950. The strand line left by the high tide of October 1949 is about two yards within the alder thicket behind the tent.

of the northwest storm, the waves probably threw flotsam two or three feet above the level of still water.

Human memory and judgment, unaided by measurements, are obviously likely to be unreliable in matters of this kind. It would therefore be unwise to take the statements of James Bay residents entirely at their face value and assume that the 1949 tide has been the absolute highest in that region, even since the beginning of this century. Moreover, on the north side of one of the Paint-hills Islands, a strand line about 6 inches above the 1949 line contained pieces of wood in which there were well preserved small nails that could hardly have been more than twenty-five years old. Even so, a tide 5 to 6 feet above normal is sufficiently infrequent to be considered remarkable by the James Bay residents. This casts doubt on Low's estimate (1889, p. 32J) of a rise of 7 feet above ordinary high water on the east coast of Akimiski Island during a moderate gale on 8 August 1887<sup>1</sup> as well as on his theory that all the driftwood strand lines in James Bay could be accounted for by storm tides.

Driftwood strand lines are a conspicuous feature of the east coast of James Bay. Their best development is in the small, open bays which are exposed to north and west winds. Bell (1879, p. 32C) says that the highest of these lines were 30 and, in places, 40 and 50 feet above sea level, and Low (1889, p. 32J) that they were 10, 20, and occasionally 30 feet above ordinary high water. In neither case do the figures appear to result from actual measurements, and they may therefore have been exaggerated,<sup>2</sup> but in 1949, R. W. Packer (in letter) found by instrumental levelling that the highest line of driftwood on the northern side of Solomons Temple Island was 24 feet above high tide on July 15 and 16, just after spring tides. This is about 17 feet above the unusual 1949 tide, or 14 feet if it be assumed that driftwood would be thrown 3 feet farther up the comparatively exposed Solomons Temple beach. The 'Admiralty navigation manual' (1938, p. 352) says that flood level reached on the shore near a cyclone centre is sometimes as much as 15 feet above predicted high tide level. In eastern Canada, however, the maximum recorded height of any storm tide ('Tide tables', 1949) appears to have been on 6 October 1869 in the Bay of Fundy, when the water in Cumberland Basin was raised 6.2 feet above the normal height at perigee springs (Dawson, 1920, p. 27).

Ruling out the possibility of a cataclysmic disturbance, since this would account for only the one strand line whereas there is a series of strand lines

<sup>1</sup>Low (1889, p. 32J) obtained this figure by subtracting 5 feet, which he considered the ordinary rise of tide, from 12 feet which was the depth of water at midnight at the place where he had beached his boat at 8 p.m. Apart from the fact that the ordinary rise at spring tides (8 August 1887 was a spring tide) on the east coast of Akimiski Island is probably more than 5 feet (and the tide may have been unusually low at 8 p.m. as there had been a southerly wind (Low, 1887) during the day), there is the possibility that the anchor had dragged and the boat's position had changed during the night. The difficulty of sounding accurately in the dark from a boat during a gale on a shoal several miles from land is obvious.

<sup>2</sup>Possibly the highest driftwood seen by Low and by Bell has disappeared during the period since their observations were made.

each one only a foot or two above the others, the higher driftwood strand lines of James Bay can only be accounted for by a fall in the sea level of at least 10 feet since their formation.

This explanation of the James Bay driftwood strand lines was first put forward by Bell (1879, p. 32C), who, judging by the rate of decay of spruce wood in that climate, estimated the rise of the land to have been between 5 and 10 feet a century. Bell, however, apparently made no allowance for storm tides, and his estimate of the age of the driftwood is based on the rate of decay for spruce. Low (1889, p. 32J) points out that the upper strand lines consisted chiefly of cedar, a much more durable wood. In 1949 and 1950 on Solomons Temple Island and the Paint-hills Islands, where conditions were suitable for the preservation of the oldest strand lines, we also noted that they were composed almost entirely of cedar.

The origin of this cedar is in itself of interest. Rupert House Indians still make cedar canoes from wood growing near the rivers which flow into Rupert Bay, but the proportion of cedar among recent driftwood is small. Even if a 15-foot tide were to combine all the strand lines except the highest one or two (which are now almost entirely cedar), far fewer cedar logs would be found in it per 100 yards of shoreline than there are in the top strand line. It may therefore be that this highest strand line dates from a time when cedar grew in considerably greater quantity than at present along the rivers flowing into James Bay.

It is to be hoped that the age of the driftwood strand lines in James Bay may before long be accurately measured by tree ring analysis.

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