TSUNAMI OF MARCH 27-29, 1964
WEST COAST OF CANADA

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DEPARTMENT OF MINES AND TECHNICAL SURVEYS
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The destructive Alaskan earthquake which occurred at 03:36:13 GMT March 28th, 1964 resulted in the death of 65 people in the area of the epicentre. Widespread property damage occurred in the communities of this area. The following data have been published (United States Coast and Geodetic Survey, 1964).

Origin Time	03:36:13.0 ± .14 seconds
Latitude	61.05° North ± 0.022°
Longitude	147.50° West ± 0.051°
Depth	20 km
Magnitude	(M) 8.4 Pasadena; $8\frac{1}{2}$ - $8\frac{3}{4}$ Berkeley; 8.6 Palisades; 8.5 C&GS (from Wood-Anderson at Albuquerque)

A large number of aftershocks were recorded from an area extending to about 400 miles southwest of the epicentre of the main shock. This suggests that the area from which energy was released in the main shock may also have been this large.

In Canada, earth tremors were noticed in the Yukon Territory and the northern part of British Columbia. Very noticeable motions in buildings and other structures were reported generally as far south as towns along the Canadian National Railroad east of Prince Rupert. Light fixtures on long suspensions were set swinging as far distant as Vancouver and Calgary. Seiches and fracturing of ice occurred on lakes on Vancouver Island and in the interior of British Columbia. These earth tremors produced no damage in Canada.

The tsunami produced by the earthquake swept southward along the British Columbia coast, and into the coastal passages and fiords. It penetrated up rivers, and was even recorded at Pitt Lake, a fresh water tidal lake

over 30 miles from the sea. It arrived at most points during the hours of darkness, after 9 p.m. March 27th on the northern B.C. coast (0500 March 28th GMT) and about midnight at southern Vancouver Island.

The tsunami waves were larger than any previously recorded on the B.C. coast. In some inlets they crested above extreme tidal high water, and swept into built up areas. Damage was extensive and the loss was estimated by insurance adjusters at $2,500,000 to $3,000,000. The most severe damage occurred at the head of Alberni Inlet in residential and industrial structures in the twin cities of Alberni and Port Alberni.

The tsunami was recorded on twelve gauges of the Canadian Hydrographic Service. An additional record was obtained from Ocean Falls through the courtesy of Crown Zellerbach Ltd. Water Resources Branch, Department of Northern Affairs and National Resources, has provided water level diagrams showing the tsunami on the Fraser and Somass Rivers. Most of these records have been transcribed to the same time and amplitude scales and are reproduced in the appendix. See Figures 1 to 4. Pacific Standard and Greenwich Mean Times are both shown on these diagrams. A list of all the gauges and their locations is included in Table 1, and these places appear on the reference maps, figures 5 and 6.

The tide records at Tasu Sound and Ballenas Islands were obtained from pressure gauges. These each had a submerged pressure diaphragm with a capillary air tube to the gauge. All other records were produced by float-actuated gauges, employing a stilling well with an inlet hole to supress most of the short period waves. Some suppression of the tsunami waves may have occurred in both the pressure and the float gauges.

The gauge at Ocean Falls is located at the power house about 1000 feet inside the river mouth. For this reason low tides are not recorded, and do not appear in Figure 1. The time scale of the original record was 0.1 inches per hour, and has been expanded in the transcription.

TABLE 1

Gauge Station	Lat.	Long.	Initial Wave				Maximum Rise or Fall		
			Time of Arrival GMT	Period 1st to 2nd Crest	Initial Rise, feet	Following Fall	Time of Beginning	Duration	Height
Ocean Falls	52 21	127 41	0800	32 min.	7.2	12.5	0825	15	12.5F
Prince Rupert	54 19	130 20	0652	92	1.4	5.8	0812	56	8.9R
Bella Bella	52 10	128 08	0653	39	3.2	6.3	0724	20	6.3F
Tasu	52 45	132 01	0533	70	2.9	6.3	0552	22	6.3F
Alert Bay	50 35	126 56	0739	29	3.8	5.7	0753	18	5.7F
Tofino	49 09	125 55	0700	20	3.4	5.1	0850	24	8.1F
Port Alberni	49 14	124 49	0800	87 (est.)			More than 17		
Victoria	48 25	123 24	0802	50	2.2	4.8	0818	39	4.8F
Fulford Harbour	48 46	123 27	0835	40	1.3	1.4	1353	22	2.0R
Pt. Atkinson	49 20	123 15	0907	90	0.3	0.7	1250	52	0.8R
Vancouver	49 17	123 07	0920	120	0.2	0.5	1105	45	0.6R
Port Moody*	49 17	122 52	1053		0.2	0.4			
Ballenas Is.*	49 20	124 09	0914						
Steveston	49 07	123 12	0945						
Deas Island*	49 08	123 03	1000						
Fraser North Arm	49 12	123 05	1015						
New Westminster	49 12	122 54	1030						
Pitt Lake	49 26	122 31	1200						

* Diagrams from Ballenas Islands, Port Moody, and Deas Island have not been reproduced in Figure 4, since they differ only slightly from Point Atkinson, Vancouver, and Steveston, respectively.

The times on this gauge record may be out by several minutes.

The Port Alberni tide gauge was put out of action during the first wave of the tsunami. It recorded a portion of the second wave between 0917 and 0930 GMT, as shown in Figure 3, and was restored to action at 1608. The times and amplitudes of the first three wave crests have been deduced. The height of the second crest, 20.9 feet above tidal datum, was established from water marks on buildings, and the time shown for this crest was projected from the recorded portion of the wave. The first three waves travelled up the Somass River, and were registered on the Water Resources Branch gauge $3\frac{1}{2}$ miles above Alberni. The crests, measured from the level of the river immediately prior to their arrival, rose to the following heights:

0.8 feet at 1016 GMT (approx.)
2.6 feet at 1153 GMT (approx.)
1.0 feet at 1330 GMT (approx.)

In deducing the missing Port Alberni record it has been assumed that the same time and height intervals between these crests occurred at Port Alberni as at the Somass River gauge.

The Fraser River records shown on Figure 4 are transcribed from Water Resources Branch diagrams. Steveston, North Arm, and New Westminster are reduced from an original time scale of 0.4 inches per hour; Pitt Lake has been expanded from 0.1 inches per hour.

The smoothed curves superimposed on the Hydrographic Service gauge records, Figures 2, 3, and 4, represent predicted tides. These have been produced on a Doodson-Lege twelve-component analog computer. The rise or fall of wave crests listed in Table 1 have been scaled from these smoothed curves, to eliminate normal tidal movement from the wave measurements. Diagram time on the Hydrographic Service gauge records will have a probable error of about $\pm$ 2 minutes and heights will have a probable error of about $\pm$ 0.1 feet.

The heights reached by the maximum tsunami wave crest were measured at a number of Vancouver Island ports where no tide gauges were operating. These are compared in Table 2 to the elevations of higher high water, large tide. Elevations at some permanent gauging stations, showing normal and extreme recorded high waters are also included for comparison.

TABLE 2

Port	Lat.	Long.	Tsunami Crest	H.H.W.	Diff.	Extreme High Tide
Port Alice	50 23	127 27	19.3	14.0	+5.3	
Klaskino	50 18	127 44	19.2	13.7	+5.5	
Fair Harbour	50 04	127 07	21.0	13.6	+7.4	
Amai Inlet	50 06	127 05	19.0	13.5	+5.5	
Zeballos	49 59	126 51	16.8	13.6	+3.2	
Esperanza	49 52	126 44	15.2	13.6	+1.6	
Tahsis	49 55	126 40	16.4	14.0	+2.4	
Gold River	49 41	126 07	17.7	14.0	+3.7	
Hot Springs Cove	49 22	126 16	20.5	13.1	+7.4	
Tofino	49 09	125 55	14.0	13.2	+0.8	15.60
Franklin River	49 06	124 49	20.6	13.0	+7.6	
Port Alberni	49 14	124 49	20.9	12.2	+8.7	14.8
Victoria	48 25	123 24	8.4	9.6	-1.2	12.10
Prince Rupert	54 19	130 20	25.2	24.6	+0.6	26.18

A far larger tsunami wave occurred at Shields Bay, on the west coast of Queen Charlotte Islands (Lat. 53 19, Long. 132 25). The crest, reported to be 17 feet above spring high water (or 32 feet above tidal datum, severely damaged a logging camp.

The shock waves from the earthquake produced an oscillation of the water surface in some lakes, rivers, and tidal waters. These disturbances commenced at approximately the time of arrival of the earthquake surface

waves, and were recorded on some of the gauge records. The periods of these oscillations were too short to be identified on the slow-moving gauge diagrams, and were less than the seiche wave periods frequently recorded on tide records. The oscillations have been transcribed with the tide diagrams, Figures 2 and 4. In Table 3 are listed the time of commencement of these oscillations, the time of their disappearance, and their maximum amplitudes.

TABLE 3

Gauge Station	Lat.	Long.	Characteristics of Oscillation		
			Begins	Ends	Max. Amplitude
Prince Rupert	54 19	130 20	0339 GMT	0405	0.25 feet
Bella Bella	52 10	128 08	0341	0418	0.35
Tasu	52 45	132 01	0342	0406	1.10
Victoria	48 25	123 24	0345	0358	0.15
Pt. Atkinson	49 20	123 15	0345	0418	0.40
Vancouver	49 17	123 07	0342	0355	0.40
Port Moody*	49 17	122 52	0346	0359	0.35
Ballenas Is.*	49 20	124 09	0346	0420	0.40
New Westminster	49 12	122 54	0344	0400	0.15
Link Lake, near Ocean Falls*	52 21	127 41	0340	0440	0.26
Cambridge Bay, N.W.T.*	69 07	105 04	0344	0359	0.30

(* Not included in Figures 2 and 4)

Reference:

Preliminary Report, Prince William Sound, Alaskan Earthquakes March - April, 1964. Coast and Geodetic Survey, United States Department of Commerce, Washington 25, D.C.

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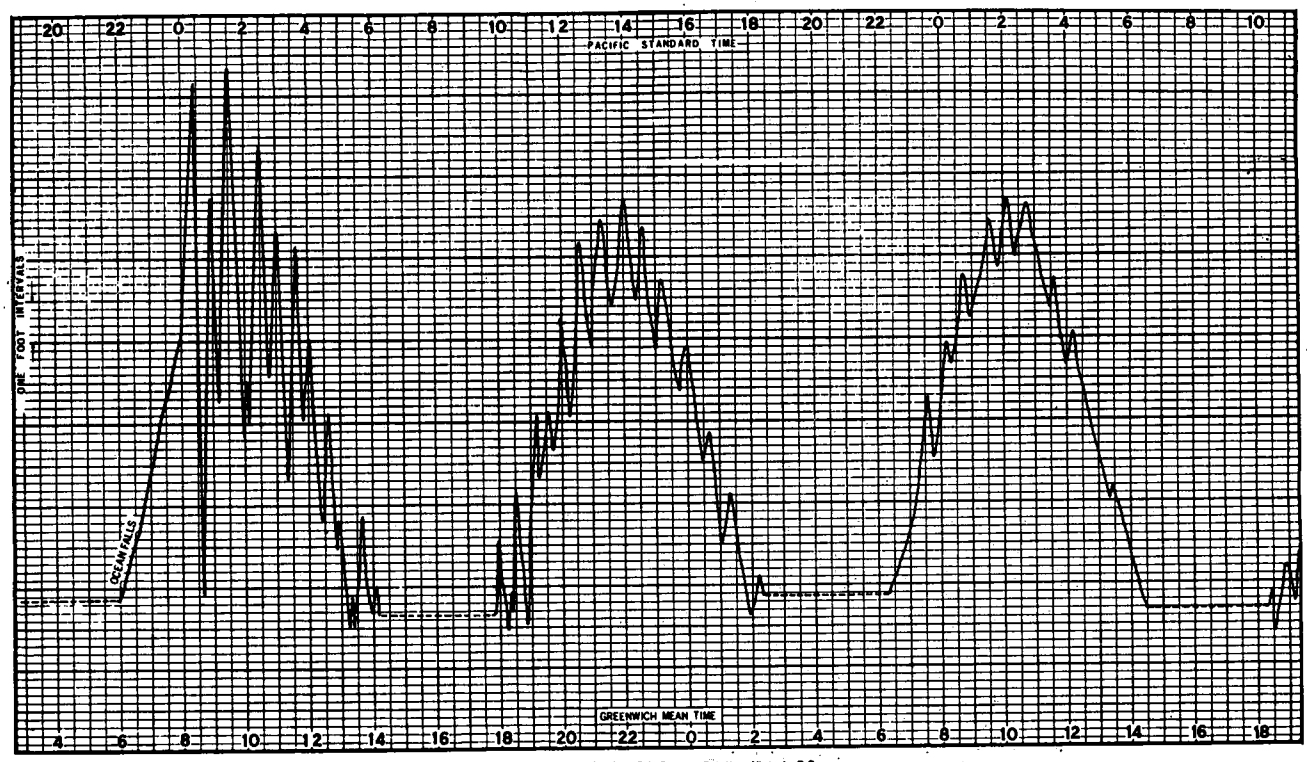

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Figure 1

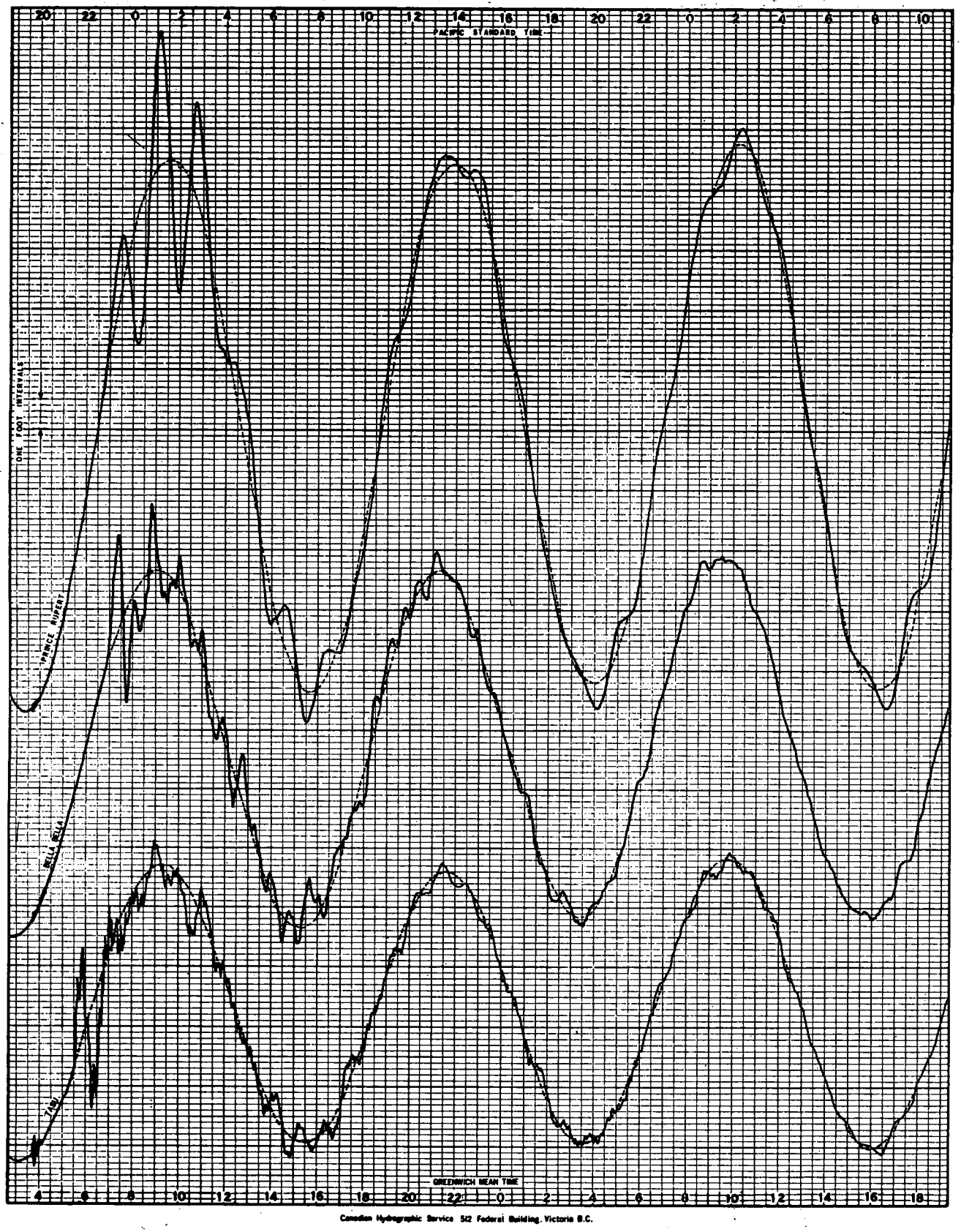
TSUNAMI
WEST COAST OF CANADA
MARCH 27-29 1964
PACIFIC STANDARD TIME
ONE FOOT INTERVALS
PRINCE RUPERT
BELLA BELLA
TOFINO
GREENWICH MEAN TIME
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Figure 2

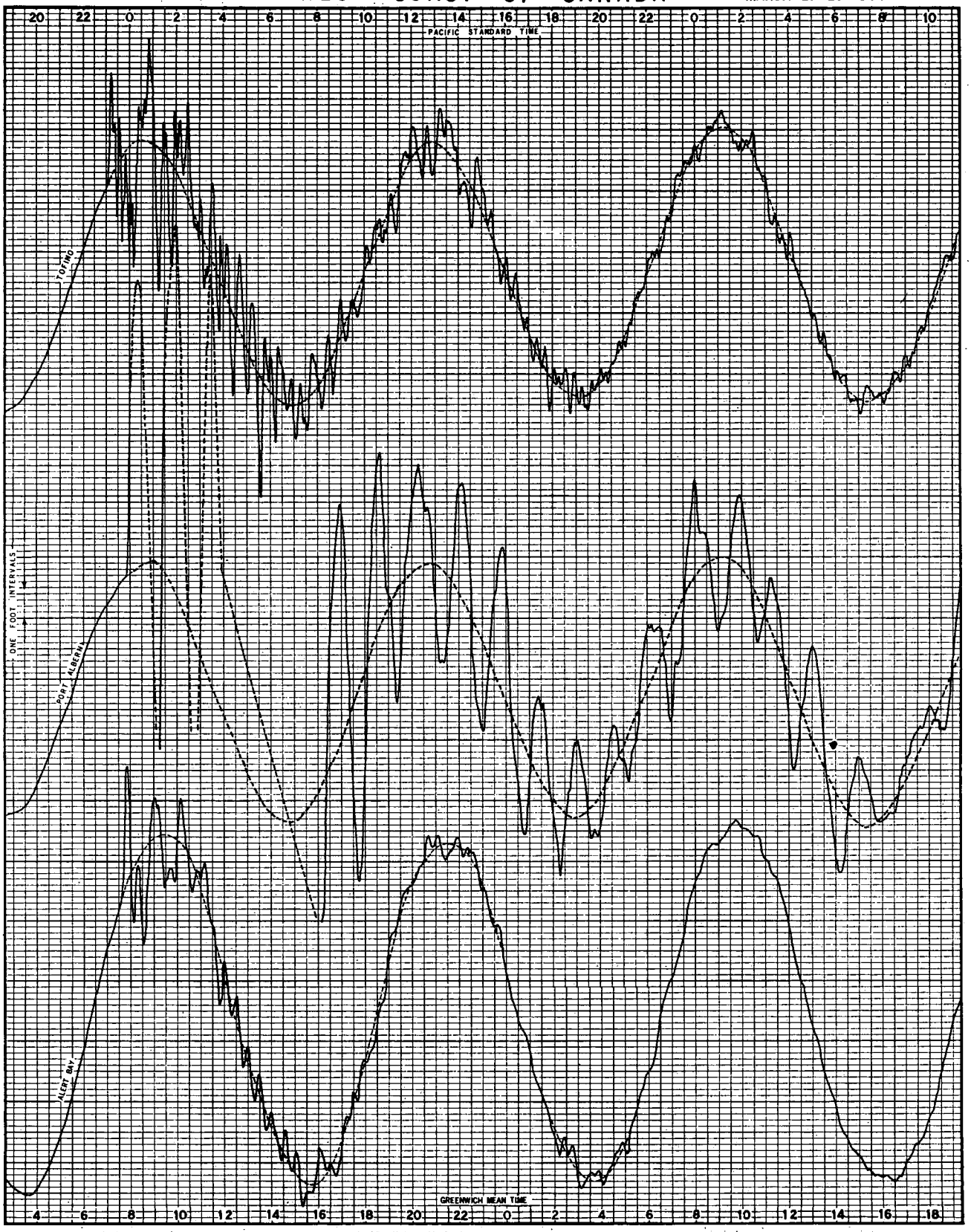
TSUNAMI
WEST COAST OF CANADA
MARCH 27-29 1964
PACIFIC STANDARD TIME
TOFINO
PORT ALBERNI
ALERT BAY
ONE FOOT INTERVALS
GREENWICH MEAN TIME
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Figure 3

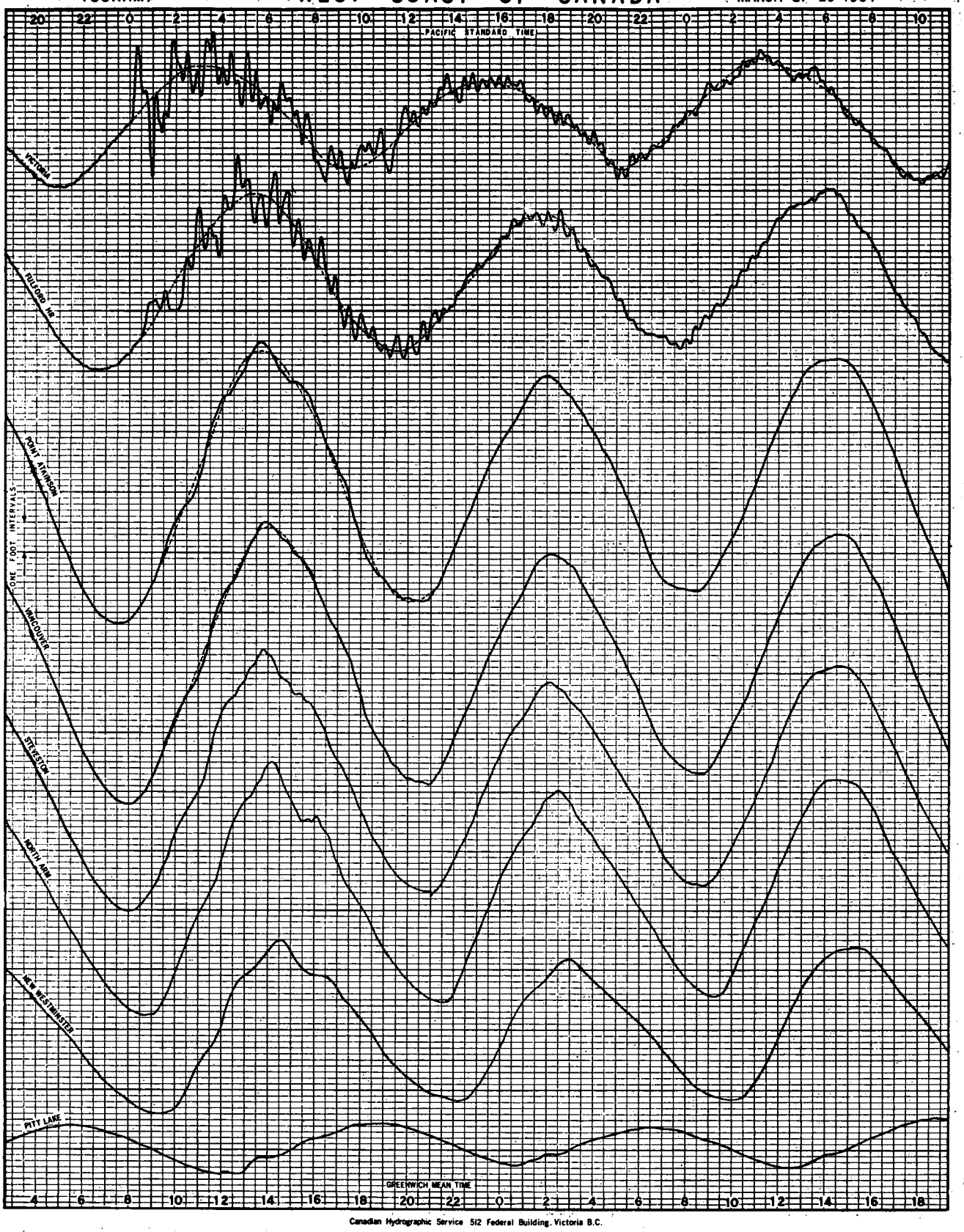

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Figure 4

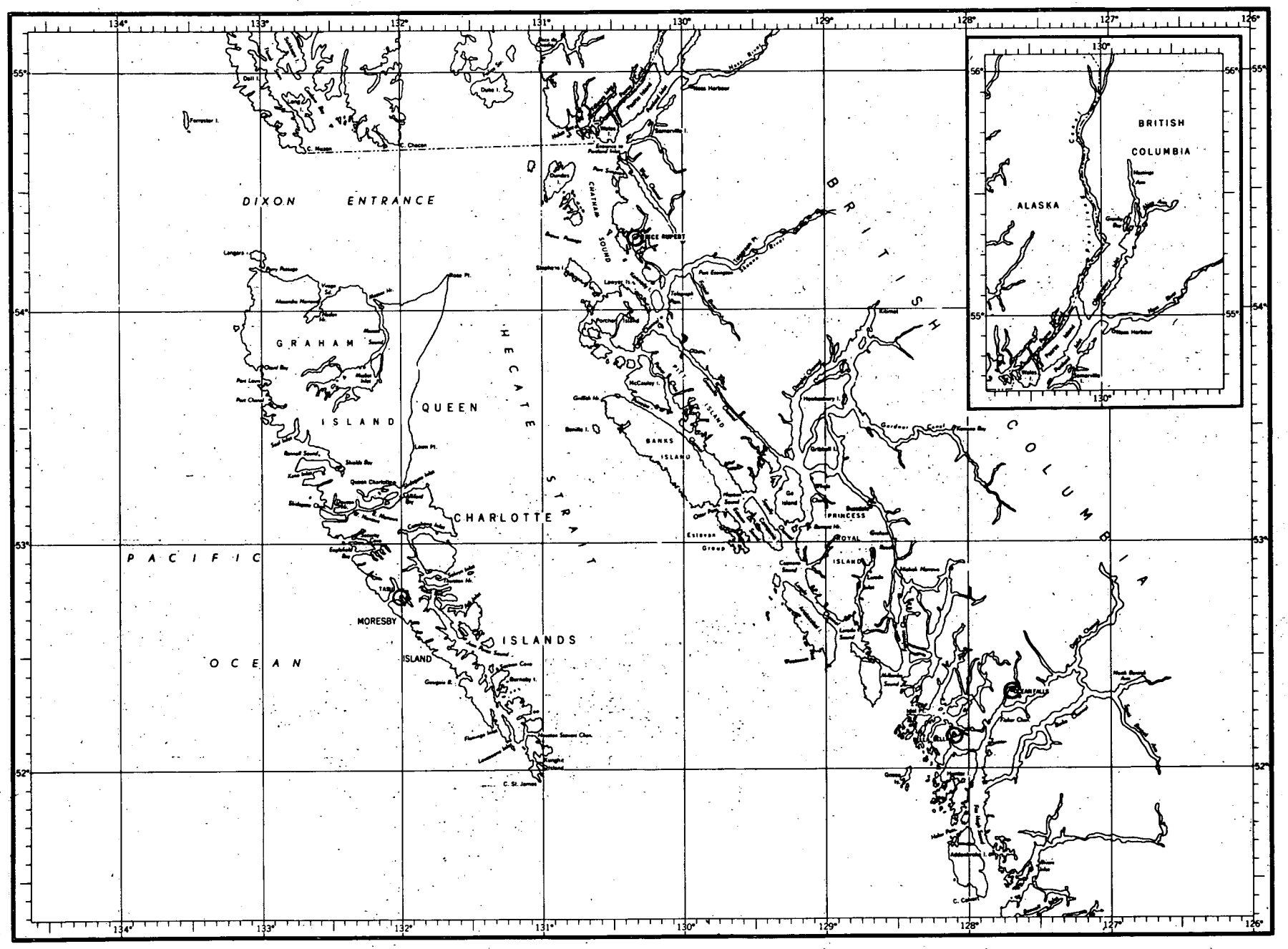
DIXON ENTRANCE
HECATE STRAIT
QUEEN CHARLOTTE ISLANDS
GRAHAM ISLAND
MORESBY ISLAND
PACIFIC OCEAN
BRITISH COLUMBIA
PRINCE RUPERT
PRINCESS ROYAL ISLAND
BANKS ISLAND
ALASKA
BRITISH COLUMBIA

Figure 5

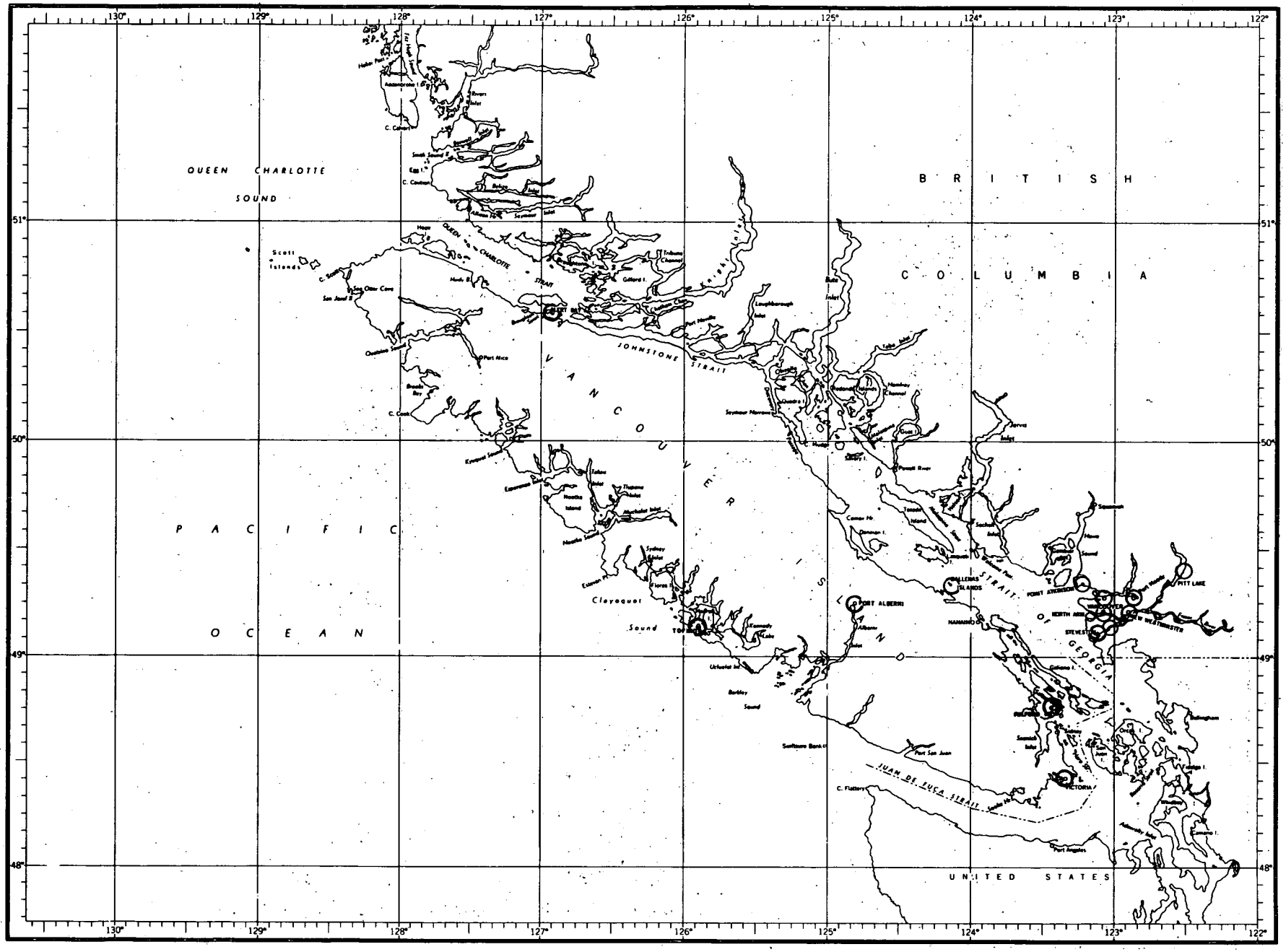
QUEEN CHARLOTTE SOUND
BRITISH COLUMBIA
PACIFIC OCEAN
VANCOUVER ISLAND
Scott Islands
JOHNSTONE STRAIT
Clayoquot Sound
JUAN DE FUCA STRAIT
STRAIT OF GEORGIA
UNITED STATES
130°
129°
128°
127°
126°
125°
124°
123°
122°
51°
50°
49°
48°

Figure 6