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Canadian West Coast Earthquakes, 1953

BY

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ABSTRACT

In 1951 the Dominion Observatory began a program of studying the earthquakes of southwestern British Columbia. The present paper lists 150 earthquakes recorded during 1953; this brings to 443 the number of tremors recorded since the inception of the program in August, 1951. The new epicentres are tabulated and plotted on a map of southwestern British Columbia. A detailed map of south Vancouver Island shows all the epicentres recorded in this area throughout the program.

The paper also gives the details of the newly built and newly equipped Victoria station.

INTRODUCTION

This report is a continuation of the investigation of local earthquakes in western sections of Canada. The first report was made for the latter half of 1951¹, and a subsequent list of tremors was published for 1952². Data for locating the epicentres are obtained from the Victoria, Alberni, and Horseshoe Bay seismograph stations, and quite often from neighbouring United States installations.

DESCRIPTION OF STATIONS

A new office building for the Dominion Astrophysical Observatory was completed in June, 1953. This building provides office space and dark-room facilities for the seismological section, as well as much larger vaults than had previously been available. Three component Benioff variable reluctance seismographs were ordered for these new vaults and it was planned to take the existing Benioff vertical to Seven Falls. As it turned out it was necessary to make the transfer to Seven Falls before the new Benioff recorder had been received, so that for some time the Victoria station was without short-period instruments.

The schedule of the move from the old to the new vaults was as follows:

January 1 to July 3.....	Milne-Shaw horizontal seismographs and original Benioff vertical seismograph operating in old vault.
July 3 to September 6.....	Milne-Shaw horizontals and new Benioff vertical in new vault.
September 6 to October 23.....	Milne-Shaw horizontals only recording in new vaults.
October 23 to December 4.....	Milne-Shaw horizontals in new vault. Benioff vertical seismometer ($T_v = 1$ sec.) recording through Leeds and Northrup galvanometer ($T_g = 1.9$ sec.) in new vault. Magnification unknown, microseisms very large.
December 4 to December 31.....	All new seismometers (3 component Benioff short-period only) and Milne-Shaw horizontals recording in new vault.

¹ W. G. Milne and F. Lombardo, "Canadian West Coast Earthquakes, 1951", *Publications of the Dominion Observatory*, Vol. XVI, No. 3, 1952.

² W. G. Milne, "Canadian West Coast Earthquakes, 1952", *Publications of the Dominion Observatory*, Vol. XVI, No. 9, 1953.

The operation from December 4th on has been as intended for the permanent installation. The Milne-Shaw seismographs, being long-period instruments, are of use primarily in recording teleseisms, not the local tremors reported here. The short-period Benioff seismographs are operated conventionally, ($T_s = 1$ sec., $T_g = 0.2$ sec.). Damping during the period covered by this paper was slightly less than critical, and the gain is set at about $\frac{2}{3}$ scale, which is the limit allowable because of microseismic amplitudes. It is estimated that this represents magnification of 10,000 to 15,000.

There has been no change in the timing arrangements at Victoria. Time marks are placed on the records by a pendulum clock. Time signals from NPG (San Francisco) are recorded, when they can be received, at 0^h, 6^h, 12^h, and 18^h G. M. T.

The new vault is some distance removed from the previous one. This has necessitated the redetermination of the station co-ordinates. The two sets of co-ordinates, as well as those of Alberni and Horseshoe Bay, are given in Table I.

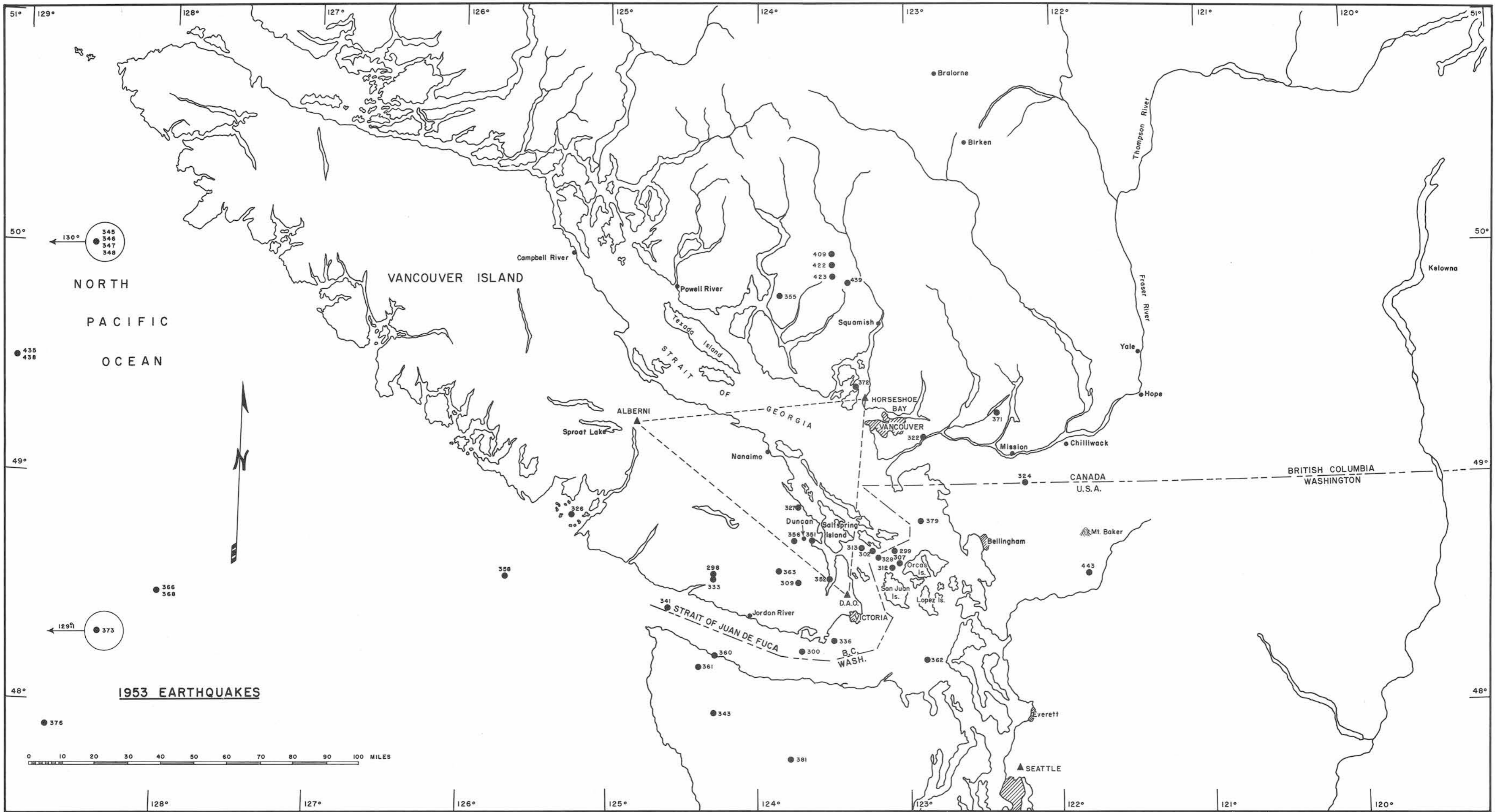
TABLE I

Station		Latitude			Longitude		
		°	'	" N	°	'	" W
Victoria	1 Jan. to 3 July	48	31	14	123	24	56
Victoria	4 July to 31 December	48	31	09.9	123	24	55.1
Alberni		49	16	14	124	49	18
Horseshoe Bay		49	22	39	123	16	33

At Alberni the instrumentation is the same as that installed in 1951. Willmore-Sharpe seismometers record through Turner galvanometers on a Sprengnether three-component recorder. Canadian Broadcasting Corporation time signals from the Dominion Observatory, Ottawa, are placed on the records automatically at 18^h G. M. T. WWV signals are usually put on, in addition, at 3^h. At Horseshoe Bay the instrumentation is now the same as at Alberni. At both stations T_s is approximately $\frac{1}{3}$ sec. and T_g is about $\frac{1}{10}$ sec. In both locations the instruments are very sensitive to traffic noise.

The time signals broadcast over CBU, Vancouver, by the Canadian Broadcasting Corporation, and recorded at Alberni and Horseshoe Bay, are carried from Ottawa to Vancouver by wire. The NPG signals recorded at Victoria are received directly from San Francisco by short-wave receiver. The fact that these two signals travel to the seismic network by two different media raised the question whether there might be a small difference between the two time standards used.

An opportunity arose of recording both CBU and NPG signals on a single record. Within the limits imposed by the slow paper speed of 60mm/min. no difference in the two sets of signals could be detected. Since this is the paper speed normally used within the network there can be no error in the epicentre locations due to the difference in timing standards.



1953 EARTHQUAKES

0 10 20 30 40 50 60 70 80 90 100 MILES

EPICENTRE LOCATION

The system of epicentral location described in the 1951 paper is still in use. The charts used are still based on velocities determined in the Canadian Shield. Current investigations suggest that these velocities are appropriate.

The earthquakes recorded at each of the three stations (Alberni, Horseshoe Bay and Victoria) during 1953 are listed in Table II. The earthquakes are numbered consecutively with those of the two earlier papers. Epicentres have been given where possible. Epicentres of earthquakes off the coast located by the United States Coast and Geodetic Survey have been included in the table even though the data from the Canadian stations were not sufficient to allow a location.

All the epicentres regarded as dependable have been plotted on the attached map of southern British Columbia.

DETAILS OF PARTICULAR EARTHQUAKES

Yukon Tremors

Table II lists three earthquakes originating in the Yukon. It seems desirable that these should be included in the report, but it must be stressed that the Yukon is so far from the existing network of stations that only the very largest shocks from that area can be included.

The strongest of these Yukon earthquakes, with a magnitude of $6\frac{1}{2}$, occurred on January 11. The United States Coast and Geodetic Survey places the epicentre at 65°N , 133°W . We have had a report that at Mayo, some 130 miles southwest of this epicentre, buildings and telephone poles swayed, but without damage to any installations. Mayo appears to be the nearest settled point to the epicentre.

Kitimat Landslide

The seismographs did not record a series of events which occurred in the Kitimat project at about 6:30 a.m., P.S.T., on September 1. A report in the Prince Rupert newspaper is the source of the following information.

The event began with a slight tremor, sufficient to shake quite heavy objects. However, the felt area seemed to be not larger than the camp itself. An operator of a tractor working along the road, noticed the earth moving like a wave, and cracks opening in the ground. He had difficulty making his way to safety as the whole road was crumbling underfoot. There was a long crack in the earth striking from west to east, and some piling was moved 100 feet across a clearing. Further mention is made of a small tremor being felt about 6 hours before the slide.

The main damage of this event seems to be confined to a very small area, and to be connected with a landslide or subsidence. However, evidence does indicate that a slight tremor may have been the trigger to start the earth movement. It would not be surprising if, when instrumental coverage permits a study of this whole coastal area, it is found that many such small tremors exist at the heads of inlets similar to this and quite like those already being recorded from Jervis Inlet, farther south.

Ferguson

One person in the area of Ferguson reported that an earthquake was felt there on February 3rd at about 3 a.m. P.S.T. This area is in eastern British Columbia just east of Upper Arrow Lake, in the Columbia River drainage basin.

DISCUSSION OF EPICENTRES

There are several points worth noting in the distribution of the 1953 epicentres. The first concerns the concentration of epicentres in the vicinity of Jervis Inlet (Nos. 409, 422, 423, 439 and 440). None of these earthquakes were large, but a trend first noted in the 1952 earthquakes is being continued. Epicentres 77, 206, 247, and 284, listed in the 1952 report, were in the same area.

Another outstanding feature of this year's activity is the number of moderately heavy tremors off the west coast of Vancouver Island. The tables show a total of 26 earthquakes in this area. Of these, 345 and 435 are the major events, the latter being of intensity at least VI. It is clear that there is a well marked area of seismic activity at some distance west of Vancouver Island, and that the intensity of events in this area is currently greater than that nearer the continent.

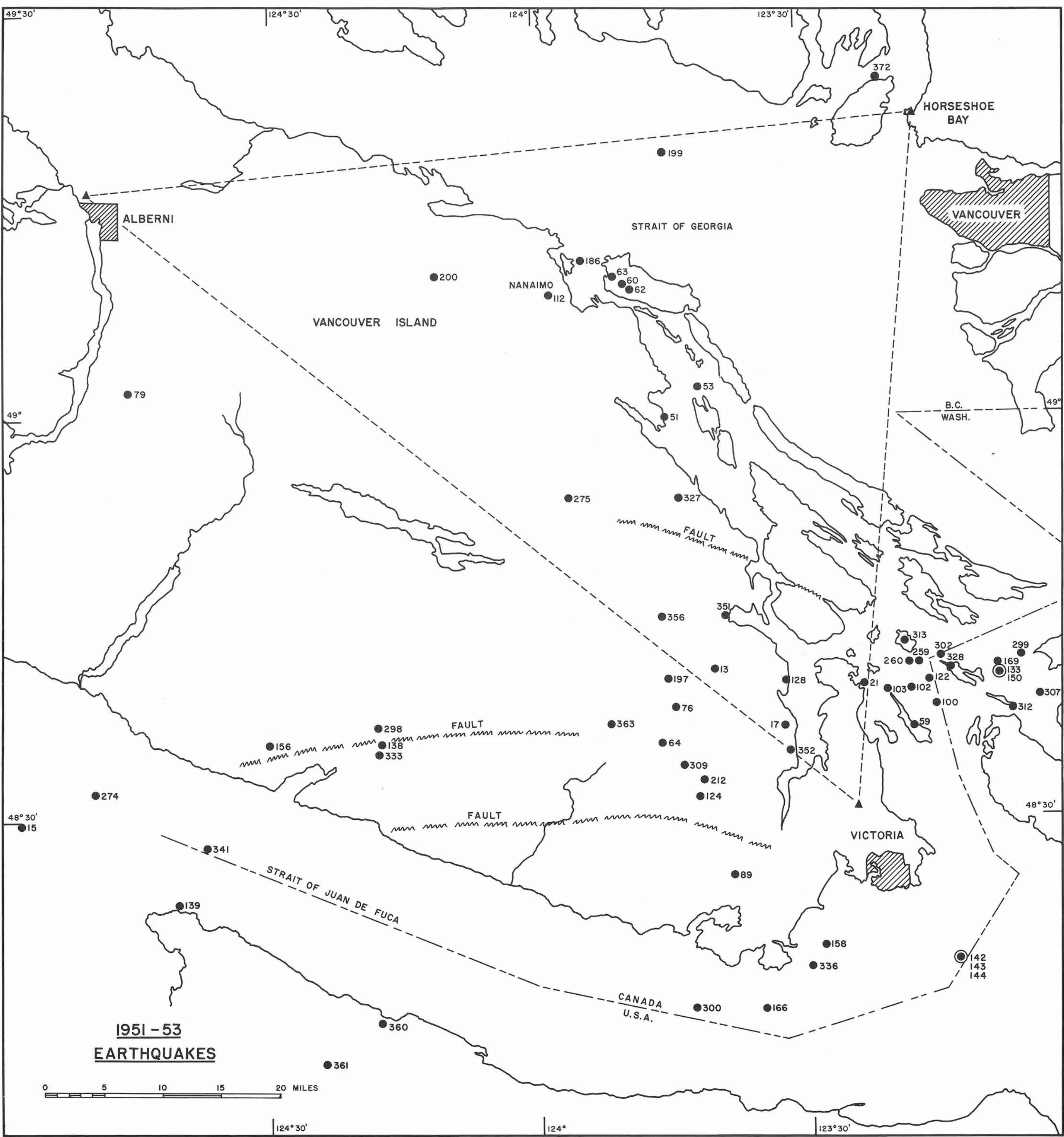
The majority of the earthquakes located seem to occur towards the southern end of Vancouver Island. The attached map shows all the epicentres located in this area since the inception of the program. The concentration of epicentres in this area may be partly due to the location of the stations but it must be largely real. The Victoria area is no more favoured by the location of the stations than the other points of the triangle.

In earlier reports it was noted that the epicentres in this area seemed to define rough lines, which might be considered to correspond to active faults. This tendency seems to be continuing, but until more evidence has accumulated no final conclusions can be drawn.

ACKNOWLEDGMENTS

Once again, thanks are due to those United States seismograph stations who have co-operated in the location of many of the epicentres listed here. Readings from Butte, Hungry Horse and Seattle have often been used, and the kindness of their seismologists in supplying them is greatly appreciated.

DOMINION ASTROPHYSICAL OBSERVATORY,
VICTORIA, B.C.,
March 7, 1955.



**1951 - 53
EARTHQUAKES**



TABLE 2—1953 EARTHQUAKES

No.	Date	Origin Time GMT	Lat. N.	Long. W.	In-tensity	Arrival Times of P-Phase, GMT			Distance			Remarks	
						Victoria	Horseshoe Bay	Alberni	V	HB	A		
			° ' ,	° ' ,					kms				
293	Jan. 7				I	13 07 19.6	13 07 32.8				96	Probably west of Bowen Island in Howe Sound.	
294	Jan. 8	05 26 04	47.5	124.5	III	05 26 19.9	05 26 30.9	05 26 29.0	95	197	182	In western Washington State.	
295	Jan. 11		65	133		22 57 38			1850			U.S.C.G.S. epicentre in Yukon, Mag 6½-6.	
296	Jan. 13				II	04 19 52.6		04 19 28.5			430	Possibly northwest of Alberni.	
297	Jan. 13				II	15 29 38.1	15 29 49.6					Probably near Seattle, Washington.	
298	Jan. 15		48 37	124 18	II	07 00 51.3	07 00 59.2	07 00 53.7	84			Near No. 138 (1952) southwestern Vancouver Island.	
299	Jan. 20	06 54 05	48 42	123 06	III	06 54 11.2	06 54 18.5	06 54 29.1	34	78	143	Waldron Island.	
300	Jan. 30	18 43 47	48 16	123 43	II	18 43 52.9	15 44 07.7	18 44 09.2	38	130	140	Strait of Juan de Fuca.	
301	Jan. 30				I		22 24 33.4		38			Strait of Juan de Fuca.	
302	Feb. 2		48 42	123 15	II	17 41 30.4	17 41 38.6	17 41 47.4	23	77	131	Gulf Islands—Victoria P/S amplitude approx. 2/1.	
303	Feb. 3	11 18 33	50 18	116 55	III	11 19 44.7	11 19 37.3	11 19 54.0	536	496	608	Felt at Ferguson, B.C. Epicentre near Duncan Lake.	
304	Feb. 12					01 31 29						Yukon.	
305	Feb. 12					04 35 25						Yukon.	
306	Feb. 20				I	00 52 27.0		00 52 16.4	113			Probably south of Alberni near canal.	
307	Feb. 20		48 39	123 04	II	05 16 38.7	05 16 46.8	05 16 57.0	31	81	146	Gulf Islands.	
308	Feb. 20							08 40 44.4				83	Off west coast of Island.
309	Feb. 21		48 34	123 44	III	11 26 39.0	11 26 50.6	11 26 52.7	25	98	111	South Vancouver Island.	
310	Feb. 24				IV	19 40 30.7	19 40 42.1	19 40 52.8	128	243	293	Felt in Seattle, Washington.	
311	Feb. 25				II	01 59 04.8	01 59 16.9					May be near No. 310.	
312	Feb. 25		48 38	123 07	III	09 29 23.9	09 29 33.3	09 29 42.9	26	86	144	Gulf Islands.	
313	Feb. 27		48 43	123 19	II	20 44 37.7	20 44 45.8	20 44 53.9	22	76	126	Gulf Islands.	
314	Mar. 4				I			09 34 15.8				72	
315	Mar. 4				I	18 32 53.5			11			Felt in Victoria.	
316	Mar. 7				I			17 02 31.4				58	
317	Mar. 7				I	21 56 08.4			17				
318	Mar. 8				II-	06 31 41.1	06 31 51.7		148			Near Seattle?	
319	Mar. 8				II+	21 54 25.9	21 54 38.6	21 54 40.6	120	226	248	In western Washington State.	
320	Mar. 10		47.5	123.5	II+	00 02 04.7	00 02 19.9	00 02 16.9				In western Washington State.	
321	Mar. 12				II-			00 45 34.4				79	

CANADIAN WEST COAST EARTHQUAKES, 1953

TABLE 2—1953 EARTHQUAKES—Continued

No.	Date	Origin Time GMT	Lat. N.	Long. W.	In-tensity	Arrival Times of P-Phase, GMT			Distance			Remarks
						Victoria	Horseshoe Bay	Alberni	V	HB	A	
			° /	° /					kms			
322	Mar. 12	19 04 11	49 12	122 54	III-	19 04 24.9	19 04 16.8	19 04 33.2	83	31	142	In Fraser River south of New Westminster, probably blasting.
323	Mar. 13	.....	.....	.....	I	01 30 36.2	.....	.....	14			
324	Mar. 14	00 58 23	49 00	122 12	II	00 58 40.6	00 58 38.6	00 58 53.8	103	91	193	Sumas Mountain, B.C.
325	Mar. 17	.....	.....	.....	I	.....	.....	06 01 00.1			10	
326	Mar. 22	20 15 57	48 52	125 15	III	20 16 19.3	20 16 22.0	20 16 06.3	140	156	57	Entrance to Barkley Sound.
327	Mar. 23	07 03 08	48 54	123 44	II	07 03 26.8	07 03 38.9	07 03 43.4	46	62	91	Near Chemainus, Vancouver Island.
328	Mar. 25	16 52 00	48 41	123 14	III-	16 52 04.6	16 52 13.0	16 52 22.0	22	77	134	Gulf Islands.
329	Mar. 27	.....	.....	.....	I	.....	.....	22 37 51.8			14	
330	Mar. 28	.....	.....	.....	I	.....	22 13 14.3	.....		48		
331	Mar. 31	.....	.....	.....	I	.....	20 46 33.2	.....		12		
332	April 2	.....	.....	.....	I	.....	.....	00 27 41.1			72	
333	April 2	07 58 33.5	48 35	124 18	II+	07 58 46.2	07 58 53.9	07 58 47.4	73	126	81	Southwest Vancouver Island.
334	April 8	.....	.....	.....	I	.....	.....	04 56 26.9			72	
335	April 8	.....	.....	.....	I	21 18 34.8	.....	.....	8			
336	April 8	22 44 09.7	48 19	123 30	II	22 44 14.8	22 44 28.9	22 44 33.1	24	115	150	South of Victoria in Strait of Juan de Fuca.
337	April 9	.....	.....	.....	II-	00 27 31.7	.....	00 27 23.6	213		79	Off west coast of Vancouver Island.
338	April 10	11 06 27.8	.....	.....	III	11 16 52.7	11 07 05.3	11 07 04.1	168	272	242	South in Washington State.
339	April 15	.....	.....	.....	I	04 55 33.5	.....	.....	104			
340	April 15	.....	.....	.....	I	14 32 35.4	.....	.....	118			
341	April 15	21 35 33.5	48 28	124 37	II+	21 35 48.7	.....	21 35 49.4	89		94	Entrance to Strait of Juan de Fuca.
342	April 19	.....	.....	.....	II	09 36 01.6	.....	09 36 19.6	137		290	Probably in Puget Sound area.
343	May 4	.....	48.0	124.3	II+	00 44 38.6	00 44 51.3	00 44 49.4	92	174	145	Western Washington State.
344	May 14	.....	.....	.....	I	01 46 47	.....	.....				Same general area as No. 345.
345	May 14	07 41 44	50	130	IV	07 42 52	.....	07 42 36.3	500		371	Off west coast of Vancouver Island, U.S.C.G.S. location.
346	May 14	18 27 41	50	130	IV	18 28 52	.....	18 28 37.2	518		405	Off west coast of Vancouver Island.
347	May 20	23 14 23	50	130	IV	23 15 33.0	.....	23 15 22.4	495		340	Off west coast of Vancouver Island.
348	May 21	12 29 51	50	130	IV	12 31 00.0	.....	12 30 47.1	490		375	Off west coast of Vancouver Island.
349	May 23	.....	.....	.....	I	.....	.....	10 04 32.8			89	
350	May 24	.....	.....	.....	I	.....	.....	04 38 13.9			76	
351	June 2	22 07 58	48 45	123 39	II-	22 07 03.5	22 07 10.6	22 07 15.4	28	75	105	South Vancouver Island.
352	June 4	00 11 03	48 35	123 32	II+	00 11 06.4	00 11 18.5	00 11 23.3	11	91	122	South Vancouver Island.

353	June	9				II	18 48 25		18 48 13-0					Probably off west coast.
354	June	9				II	23 30 03-5		23 29 43-5					Northern Vancouver Island.
355	June	11	23 37 32	49 49	123 52	III	23 37 55-5	23 37 42-5	23 37 46-8	148	63	90		Sechelt Peninsula area.
356	June	16	17 53 20	48 45	123 46	III-	17 53 27-0	17 53 33-8	17 53 36-9	34	78	98		South Vancouver Island.
357	June	19				II	22 52 23-8		22 52 23-6					Off west coast.
358	June	27	07 09 17	48-6	125-7	II+	No Time	07 09 48-5		176	202	99		Off west coast-Victoria S-P readable.
359	July	4					No Time		10 00 12-9					Off west coast.
360	July	5	13 55 07	48 15	124-3	III	No Time	13 55 32-4	13 55 26-1	63	139	115		Western Strait of Juan de Fuca.
361	July	6	09 48 34	48-2	124-4	II	No Time	09 48 58-4	09 48 52-5	80	149	114		Northwest Washington State.
362	July	11	08 13 30	48 14	122 52	III+	08 13 37-7	08 13 50-6	08 13 58-3	52	130	184		Entrance to Puget Sound.
363	July	17	08 57 45	48 37	123 52	II+	08 57 51-6	08 58 00-6	08 58 01-7	35	94	100		Southern Vancouver Island.
364	July	18				I	22 29 44-7							
365	July	21				III	08 54 00-6							
366	July	22	10 17 39	48-5	128	IV+	10 18 32-4		10 18 22-4	425		326		U.S.C.G.S. location.
367	July	22				III	10 37 05-0		10 36 55-8					Probably off west coast.
368	July	22	10 37 20	48-5	128	IV+	10 38 13-0		10 38 03-3	415		330		U.S.C.G.S. location.
369	July	26				II	17 47 50		17 47 28-3					Off west coast.
370	July	28				II	18 49 08		18 48 50-1					Off west coast.
371	July	29	06 00 48	49-3	122-4	II		06 00 58-4	06 01 15-2		59	173		Due east of Horseshoe Bay between Pitt and Stave Lakes.
372	Aug.	1	05 33 10	49 25	123 21	II	05 33 27-7	05 33 12-7	05 33 28-7	102	8	108		Between Gambier and Bowen Islands, Howe Sound.
373	Aug.	4	10 26 22	48-3	129-1	IV+	10 27 17-3	10 27 20-5	10 27 06-5	420	437	325		Off west coast.
374	Aug.	4				II			10 54 13-4					Same as No. 373.
375	Aug.	4				II			11 08 31-3					Same as No. 373.
376	Aug.	4	11 35 27	47-9	128-7	IV	11 36 25	11 36 25-2	11 36 11-0	400	427	320		Off west coast.
377	Aug.	6				I	23 29 26-7							
378	Aug.	9				I		05 50 43-9						Very close to Horseshoe Bay.
379	Aug.	10	11 22 25	48 50	122 55	III	No Time	11 22 34-5	11 22 49-2	49	60	146		Strait of Georgia.
380	Aug.	16				II	06 15 45-1		06 15 56-9					Probably off west coast.
381	Aug.	20	18 32 41	47-8	123-8	III	18 32 52-9		18 33 08-9	79		173		In Olympic Mountains.
382	Aug.	20				I			20 37 24-5					
383	Aug.	21				I			23 51 12-0					
384	Aug.	26				I			23 23 03-1					Nos. 382, 383, 384 are alike in appearance.
385	Aug.	29				I	04 30 43-0							
386	Aug.	31				I	04 46 24-7							
387	Sept.	4				II	18 44 46-7		18 44 24-2					Probably in Washington.
388	Sept.	7				I	23 29 32-8							
389	Sept.	8				I	00 12 38-6							
390	Sept.	8				I	11 42 25-5							
391	Sept.	8				I	11 54 04-9							
392	Sept.	10				I			14 36 43-3					

TABLE 2—1953 EARTHQUAKES—*Concluded*

No.	Date	Origin Time GMT	Lat. N.	Long. W.	In-tensity	Arrival Times of P-Phase, GMT			Distance			Remarks
						Victoria	Horseshoe Bay	Alberni	V	HB	A	
			° ' ,	° ' ,					kms.			
393	Sept. 12				I			19 09 25.4				
394	Sept. 13				I			00 12 05.3				
395	Sept. 15				I			19 10 00.3				
396	Sept. 19				I			23 30 40.1				
397	Sept. 23				I			21 30 09.3				
398	Sept. 23				I			21 58 49.3				
399	Sept. 23				I			21 59 37.9				
400	Sept. 25				I			21 10 02.9				
401	Sept. 29				I		15 59 12.8		123			
402	Sept. 29				II		16 31 15.1	16 31 15.3	210	211	Probably south.	
403	Sept. 30				II		19 36 28.9	19 36 31.1	114	132		
404	Sept. 30				I			22 22 54.5			66	
405	Oct. 1				I			09 00 26.3			50	
406	Oct. 2				I			00 27 17.0			80	
407	Oct. 2				I		06 11 00.9		74			Probably in Sechart area.
408	Oct. 4				I			07 43 30.9			34	
409	Oct. 4	19 41 14	50.0	123.5	III		19 41 28.9	19 41 32.4	76	116		Probably in Sechart area.
410	Oct. 8				I			18 59 49.9			72	
411	Oct. 10				I			23 59 56.4			54	
412	Oct. 11				I			11 44 41.0			94	
413	Oct. 12				I			17 54 17.9			52	
414	Oct. 13				I			08 28 08.0				Off west coast?
415	Oct. 13				II			08 56 30.9				Off west coast?
416	Oct. 13				I			15 26 58.6			460	
417	Oct. 13				I			17 13 28.8			325	
418	Oct. 13				I			21 30 57.7			74	
419	Oct. 21				I		S-P only	06 57 37.4	100	130		North of Sechart?
420	Oct. 27				I			15 44 50.4			48	
421	Oct. 29				I			04 20 02.8			76	
422	Oct. 31	00 10 58.6	49.9	123.5	II		00 11 11.6	00 11 17.3	68	111		North of Sechart?
423	Oct. 31	16 29 43.5	49.9	123.5	II		16 29 54.8	16 30 01.9	64	109		North of Sechart?
424	Nov. 2				II			01 59 32.3			108	
425	Nov. 3				I			08 13 58.1			66	
426	Nov. 4				I		11 26 10.8	11 26 18.9			110	North of Sechart?

427	Nov.	7				I			22 53 23.6		58		
428	Nov.	9				II	S-P only		22 09 31.9	84	110	Western Olympics?	
429	Nov.	18				I		10 25 50.7			37		
430	Nov.	20				I		06 31 42.6			20		
431	Nov.	23				I		10 45 27.0			13		
432	Nov.	27				II	trace		22 53 18.3		310	Off coast.	
433	Nov.	29	23 50 39			II	S-P only	23 51 07.8	23 51 07.8	86	172	196	Entrance to Puget Sound?
434	Dec.	1	20 15 44			I	S-P only		20 16 05.6	25	135		
435	Dec.	4	14 54 46	49.5	129	VI		14 54 51.5	14 54 34.4		375		U.S.C.G.S. location, registered at distances out to 80°.
436	Dec.	6				I		06 01 55.6			58		
437	Dec.	12				I	trace		08 05 33.7		370		Off west coast?
438	Dec.	12	08 28 36	49.5	129	III	08 29 44.9		08 29 28.7	430	375		Off west coast?
439	Dec.	12	09 47 27	49.7	123.4	II		09 47 36.5	09 47 46.5		50	116	Northeast of Sechelt.
440	Dec.	12	12 20 18	49.7	123.4	II		12 20 27.7	12 20 37.8		52	114	Northeast of Sechelt.
441	Dec.	12				I	17 41 00		trace				Off west coast.
442	Dec.	16				I	04 32 39.8		trace				
443	Dec.	20	11 35 33.2	48.6	121.8	III	11 35 45.8	11 35 48.8	11 36 01.3	70	190		East of Bellingham.

