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## Canadian West Coast Earthquakes, 1952

BY

W. G. MILNE

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# Canadian West Coast Earthquakes, 1952

BY

W. G. Milne

## ABSTRACT

Local earthquakes recorded on the seismographs at Victoria, Alberni and Horseshoe Bay, British Columbia are tabulated, continuing a listing begun in 1951. Those twelve earthquakes which were felt are discussed separately. Epicentres are plotted on two maps, the first showing 1952 epicentres on a map of southern British Columbia, the second showing epicentres for both 1951 and 1952 shocks on a map of southern Vancouver Island. While it is yet too early to draw definite conclusions there appears to be a tendency for the epicentres to lie along definite lines, some of which coincide with known faults.

## INTRODUCTION

An enlarged program for the study of West Coast earthquakes was begun in August, 1951. New stations were installed at Alberni and Horseshoe Bay. These stations, with the existing station at Victoria, provided the three station network necessary for the location of epicentres in the coastal regions of southern British Columbia. A paper<sup>1</sup> has already been published listing the epicentres determined during the latter part of 1951. The present paper continues this listing for the year 1952.

## DESCRIPTION OF STATIONS

As during 1951 the Victoria station had as its equipment for the registering of local earthquakes a short-period vertical component Benioff seismometer. At Alberni the Willmore-Sharpe seismometers continued to operate for the whole year. No changes in the installation were made from 1951. At Horseshoe Bay the vertical and east-west components are of the Willmore-Sharpe design. A Sprengnether short-period horizontal seismograph ( $T_g = T_s = 1.9^s$ ) was substituted for the north-south component from February to October inclusive. At all other times the north-south too was a Willmore-Sharpe. The recorders at all three stations operate at a paper speed of 60 mm/min.

The time control at Alberni and Horseshoe Bay was obtained from CBU Vancouver radio time signals, recorded on the instruments at 10 a.m. each day. During November and December the Alberni station recorded Mare Island (NPG San Francisco) and WWV (Washington) time signals whenever possible. At Victoria, CBU time signals were recorded until October, when a complete change was made to NPG signals at 3<sup>h</sup>, 15<sup>h</sup>, and 20<sup>h</sup> GMT. If these signals continue to be satisfactory, a complete change-over of the network is contemplated to recording NPG signals for five minutes three times daily instead of CBU for twenty seconds once a day.

The station co-ordinates are listed below in Table 1.

## METHOD OF LOCATING EPICENTRES

The method of locating epicentres has not been changed from the method used in 1951. That is, the differences of arrival times of the P waves at pairs of stations is used with the aid of a previously constructed map to obtain an approximate epicentre. This

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

approximate epicentre and the origin time are adjusted to obtain the best fit for all three stations. The adjusted epicentre is then checked with the S-P times for each station. All of these earthquakes would appear to be from a very shallow depth. The few tremors near Victoria have an S-P time of the order of 3 seconds.

TABLE I

Station	Latitude			Longitude		
	°	'	" N	°	'	" W
Victoria	48	31	14	123	24	56
Alberni	49	16	14	124	49	18
Horseshoe Bay	49	22	39	123	16	33

Some indication of the possible error of location of an epicentre might be useful. To begin with let us assume the travel-time curves used are correct. The time error can amount to  $\pm 0.5$  sec. for any one station. This would mean an error of approximately 3 km. for one direction. The epicentre would thus lie in a circle of 3 km. radius. In addition, the travel-time curves used were developed for use in the Canadian Shield where sedimentary rocks are not present. Their use in British Columbia, where there are considerable thicknesses of sedimentary rock, must lead to additional errors in location. Until crustal studies now under way in British Columbia have been completed it is impossible to estimate the effects of these sedimentary layers.

### EPICENTRE LOCATION

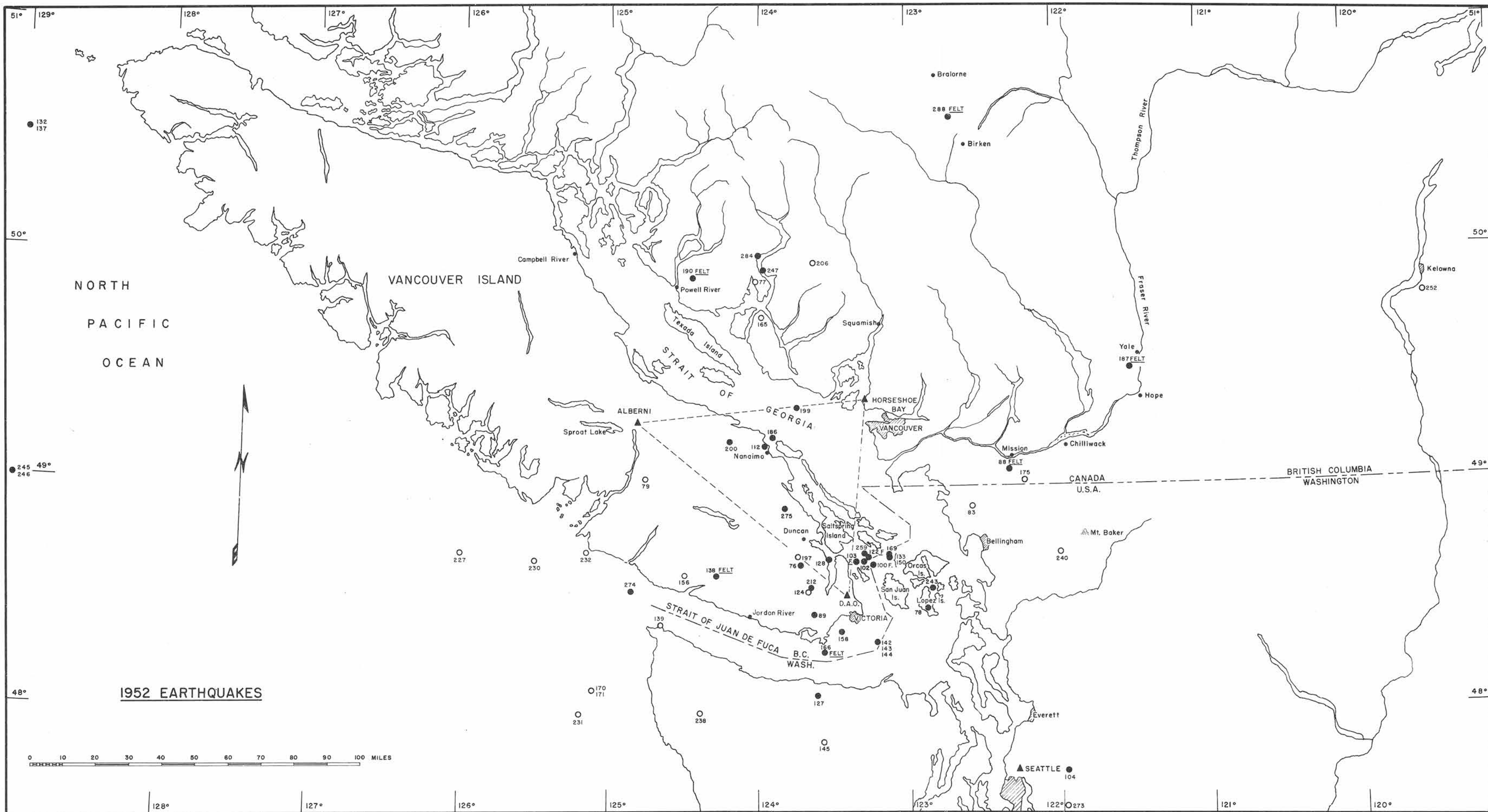
Table 2 lists the earthquakes recorded on the network stations during the year 1952. They are numbered consecutively with those of the earlier paper. All the epicentres for which satisfactory locations have been made are plotted on the attached map of southwestern British Columbia. Those epicentres which are considered to be accurately located are indicated by solid circles. For those shocks where a reading is obtained at only two stations some doubt usually exists as to which of two locations is the true epicentre. Such locations are marked on the map with open circles. Open circles are also used where an epicentre is so far from the triangle of stations that it cannot be well located. Epicentres from the United States Coast and Geodetic Survey epicentre program are included to make a total of 56 earthquakes plotted on the map.

### DETAILS OF PARTICULAR EARTHQUAKES

#### *Mission*

An earthquake (No. 88) was felt in the general area of Mission and Abbotsford about 40 miles east of Vancouver on February 6th at 14:04 hours GMT. It was investigated in the field about four days after its occurrence to try to obtain an accurate epicentre. Table 3 shows the intensities felt in the area according to the Modified Mercalli Scale.

The area in question is heavily drift covered, and is bounded on the north, east, and south by mountains. Mission, Abbotsford, and Huntington and Sumas on the United States border all felt the earthquake with about the same intensity. For this reason no single point can be chosen for an epicentre, and the record data permit a wide range of







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TABLE 2—1952 EARTHQUAKES—Continued

No.	Date	Origin Time GMT	Lat. N.	Long. W.	Intensity	Arrival Times of P-Phase, GMT			Distance			Remarks
						Victoria	Horseshoe Bay	Alberni	V	HB	A	
			°	°					kms			
108	Feb. 24	.....	.....	.....	.....	.....	5 57 17	.....	.....	.....	.....	Teleseism.
109	Feb. 26	.....	.....	.....	.....	11 42 36	11 42 42.8	11 42 47.6	.....	.....	.....	
110	Feb. 27	.....	.....	.....	.....	.....	22 54 08.7	.....	.....	.....	.....	
111	Feb. 29	.....	.....	.....	I	12 40 51.5	12 40 48.0	.....	.....	.....	.....	Probably near No. 88. Near Nanaimo.
112	Mar. 2	0 11 53.6	49 10.0	123 58	III	0 12 07.4	0 12 02.9	0 12 04.0	84	57	63	
113	Mar. 3	.....	.....	.....	.....	.....	.....	9 58 56.8	.....	.....	32	
114	Mar. 3	.....	.....	.....	.....	.....	.....	14 39 02.5	.....	.....	37	Probably a blast.
115	Mar. 6	.....	.....	.....	.....	.....	.....	21 01 52.1	.....	.....	.....	
116	Mar. 7	.....	.....	.....	.....	.....	.....	20 39 00.6	.....	.....	87	
117	Mar. 7	.....	.....	.....	.....	20 53 52.9	.....	.....	.....	.....	.....	Probably a blast.
118	Mar. 8	.....	.....	.....	.....	.....	.....	15 30 35.4	.....	.....	.....	
119	Mar. 10	.....	.....	.....	.....	.....	.....	19 30 12.6	.....	.....	.....	
120	Mar. 11	.....	.....	.....	.....	.....	.....	23 54 26.3	.....	.....	.....	Felt in Victoria.
121	Mar. 12	.....	.....	.....	.....	.....	.....	0 23 30.8	.....	.....	.....	
122	Mar. 14	14 59 37.0	48 41	123 16	IV	14 59 42.6	14 59 51.5	15 00 00.1	33	70	140	
123	Mar. 14	.....	.....	.....	.....	.....	.....	15 03 51.5	.....	.....	.....	South Vancouver Island. Aftershock of No. 124. (?)
124	Mar. 16	5 50 20.9	48 32	123 41	II	5 50 24.5	5 50 37.5	5 50 45.8	22	101	117	
125	Mar. 16	.....	.....	.....	II	17 20 30.4	17 20 43.5	17 20 53.5	.....	.....	.....	
126	Mar. 20	.....	.....	.....	I	10 11 42.2	.....	10 11 58.6	31	.....	.....	Northern Olympic mountains. South Vancouver Island. South of Seattle.
127	Mar. 20	21 36 18.5	48 05	123 37	II	21 36 27.2	21 36 42.9	21 36 43.9	54	149	158	
128	Mar. 21	4 41 43.5	48 41	123 32	III	4 41 47.1	4 41 57.7	4 42 02.5	22	85	116	
129	Mar. 22	2 01 35	.....	.....	III	2 01 58.7	2 02 08.9	2 02 15.9	142	215	292	Felt in northwestern Montana and in British Columbia. U.S.C.G.S.—off coast. North of San Juan Island.
130	Mar. 27	.....	.....	.....	.....	19 30 12.7	.....	.....	120	.....	.....	
131	April 1	00 37 41.5	48.0	113.8	VII	0 39 17.8	0 39 17.6	0 39 27.1	.....	.....	.....	
132	April 3	2 13 15	50.5	129	III	2 14 23	2 14 22.4	2 14 06.1	.....	.....	.....	Off coast of northern Vancouver Island. Felt in Victoria and south west Vancouver Island. Possibly off Cape Flattery.
133	April 4	20 51 06.0	48 41	123 08	III	20 51 10.5	20 51 19.4	20 51 28.9	26	81	140	
134	April 5	.....	.....	.....	.....	1 14 05.8	.....	.....	26	.....	.....	
135	April 8	.....	.....	.....	.....	3 56 45.9	.....	.....	.....	.....	.....	Off coast of northern Vancouver Island. Felt in Victoria and south west Vancouver Island. Possibly off Cape Flattery.
136	April 8	.....	.....	.....	I	.....	.....	13 52 38.0	.....	.....	114	
137	April 8	.....	50.5	129	II	15 28 39.0	.....	15 28 21.4	.....	.....	146	
138	April 11	9 48 37.5	48 36	124 17	IV	9 48 48.6	9 48 56.5	9 48 51.3	67	116	84	Possibly off Cape Flattery.
139	April 12	.....	48 23	124 40	II	11 04 33.9	11 04 44.7	11 04 35.5	.....	.....	.....	





TABLE 2—1952 EARTHQUAKES—Continued

No.	Date	Origin Time GMT	Lat. N.	Long. W.	Intensity	Arrival Times of P-Phase, GMT			Distance			Remarks
						Victoria	Horseshoe Bay	Alberni	V	HB	A	
											kms	
177	June 7					16 51 41.7						
178	June 7					18 49 35						
179	June 12				I	13 28 59.6	13 29 13.2	13 29 32				Washington State. (?)
180	June 12				I	19 00 31.5	19 00 33.7					West of Bellingham. (?)
181	June 17				II	20 36 03.8	20 36 12.3	20 36 00.2	56	105		Entrance to Juan de Fuca Strait. (?)
182	June 18							5 11 45.2			66	
183	June 18							7 25 05.0			74	
184	June 18					10 58 57.0			106			
185	June 23				II	17 38 01.0	17 38 15.5	17 38 20.5				Probably south of Victoria.
186	June 23	23 52 42.6	49 12	123 54	III	23 52 56.5	23 52 51.3	23 52 53.2	85	51	66	North east of Nanaimo.
187	July 4		49 30	121 30	IV	22 54 57.6	22 54 50.4	22 55 07.1	148	119	256	Felt at Hope B.C. Seattle 22:55:09.
188	July 4				I		23 00 34.8			119		Aftershock of No. 187.
189	July 12				I	19 16 33.9	19 16 27.6	N.O.†		69		
190	July 15		49 54	124 27	III	10 08 36.8	10 08 29.8	N.O.†	180	93		Felt in Powell River.
191	July 16					18 59 03.7			69			
192	July 18							11 54 29.4				
193	July 18							11 55 21.1				
194	July 19		48.3	123.2	I	11 54 22.1			26			} Felt in south east of Victoria, location approximately 11 kms. from city.
195	July 19		48.3	123.2	I	11 55 14.0			28			
196	July 23					6 50 11.1			62			
197	July 23		48 41	123 45	I	10 42 01.7		10 42 13.4	28		99	Lower Vancouver Island.
198	July 26					5 12 03.4					70	
199	July 26	14 13 51.5	49 20	123 45	III	14 14 07.1	14 13 58.1	14 14 03.4	96	37	76	East of Nanaimo.
200	July 26	21 03 11.1	49 11	124 12	II	21 03 26.7	21 03 23.2	21 03 18.3	95	73	44	West of Nanaimo.
201	July 27	19 52 14	47.5	122.4	IV	19 52 37.3	19 52 45.9	19 52 56.1	140	212	292	Seattle 19:52:24.
202	July 27	20 13 49	47.5	122.4	IV	20 14 12.8	20 14 21.0	20 14 31.5	140	212	292	Seattle 20:13:59. Seattle epicentre and origin time used.
203	July 28							8 25 04.2			103	
204	July 28					19 01 49.4			110			
205	July 29							23 50 31.0			76	
206	July 30		49 58	123 38	II		7 47 10.0	7 47 19.4		112	88	North east of Powell River, east of Jervis Inlet.
207	July 30				I		9 41 12.1	9 41 30				East of Vancouver, approximately 100 kms.
208	July 30							23 34 21.9			26	

209	Aug.	2	.....	47.5	122.4	.....	15 50 00.8	15 50 08.8	.....	.....	.....	Seattle 15:49:43.
210	Aug.	6	.....	47.5	122.4	.....	17 32 17.6	17 32 31.6	.....	.....	.....	Seattle 17:32:01.
211	Aug.	6	.....	.....	.....	.....	.....	.....	21 43 17.7	25	.....	.....
212	Aug.	7	3 48 33.1	48 33	123 41	II	3 48 35.2	3 48 49.2	3 48 52.0	20	97 116	North west of Victoria.
213	Aug.	7	.....	.....	.....	.....	.....	14 35 46.6	.....	.....	.....	.....
214	Aug.	9	.....	.....	.....	.....	.....	3 42 31.5	.....	.....	.....	.....
215	Aug.	9	.....	.....	.....	.....	.....	7 48 25	7 48 06.3	.....	.....	Off west coast of Vancouver Island.
216	Aug.	9	.....	.....	.....	.....	.....	.....	13 16 58.6	.....	.....	.....
217	Aug.	10	.....	.....	.....	.....	.....	.....	14 58 03.8	56	150	.....
218	Aug.	11	.....	.....	.....	.....	22 52 12.5	.....	.....	20	.....	Felt in Victoria.
219	Aug.	11	.....	.....	.....	.....	22 59 31.3	.....	.....	.....	.....	Very near Victoria.
220	Aug.	11	.....	.....	.....	.....	23 01 09.1	.....	.....	.....	.....	Very near Victoria.
221	Aug.	18	.....	.....	.....	.....	.....	.....	6 39 23.0	.....	.....	.....
222	Aug.	19	.....	.....	.....	.....	.....	3 07 08.9	.....	.....	.....	.....
223	Aug.	20	15 24 59	43	127	IX	15 26 32.3	N.O.†	15 26 38.9	.....	.....	Off coast of Oregon. U.S.C.G.S. epicentre. M=7-7½.
224	Aug.	21	.....	.....	.....	.....	5 00 58.2	.....	.....	.....	.....	Very near Victoria.
225	Aug.	21	.....	.....	.....	.....	.....	.....	12 53 56.2	.....	.....	.....
226	Aug.	21	.....	.....	.....	.....	19 09 56	.....	.....	.....	.....	Aftershock of No. 223.
227	Aug.	25	.....	48.7	126.0	.....	2 16 19	2 16 21.2	2 16 01.6	.....	.....	Off Barkley Sound, poor location.
228	Aug.	26	.....	.....	.....	.....	9 51 50.4	.....	.....	110	.....	.....
229	Aug.	26	.....	.....	.....	.....	.....	20 05 07.0	.....	.....	.....	.....
230	Aug.	30	.....	48 40	125.5	II	19 47 34.5	.....	19 47 24.2	.....	93	Off Barkley Sound.
231	Aug.	30	.....	48.0	125.2	II	21 29 08.0	.....	21 29 08.5	143	.....	Off Washington coast.
232	Aug.	31	.....	48 42	125 08	.....	10 05 59.2	10 06 03.5	10 05 48.4	129	158 68	Off Barkley Sound.
233	Sept.	1	.....	.....	.....	.....	8 03 13.4	.....	.....	.....	.....	Seattle 8:03:08.
234	Sept.	2	.....	.....	.....	.....	3 51 20.0	.....	.....	.....	.....	Seattle 3:51:04.
235	Sept.	2	.....	.....	.....	.....	7 36 47	.....	.....	.....	.....	.....
236	Sept.	3	.....	.....	.....	.....	22 09 28.0	.....	.....	.....	.....	.....
237	Sept.	4	.....	.....	.....	.....	.....	.....	18 51 05.8	.....	.....	.....
238	Sept.	6	.....	48.0	124.4	.....	.....	10 41 28.7	10 41 42.5	.....	.....	Olympic Peninsula.
239	Sept.	9	.....	.....	.....	.....	.....	.....	8 17 57.1	.....	.....	.....
240	Sept.	13	.....	48.7	122.0	.....	22 58 57.6	22 58 59.8	22 59 14.6	110	130 230	East of Bellingham.
241	Sept.	18	.....	.....	.....	.....	.....	.....	8 52 55.3	.....	.....	.....
242	Sept.	22	.....	.....	.....	.....	.....	.....	2 40 44.4	.....	.....	.....
243	Sept.	22	7 21 46.1	48 33	122 51	III	7 21 52.7	7 22 02.0	7 22 12.5	42	98 165	Near Lopez Island.
244	Sept.	30	.....	.....	.....	.....	0 54 18	0 54 33.2	0 54 36.6	.....	200	South in Washington State.
245	Oct.	1	1 47 03	49	129	IV	1 48 01	.....	1 47 51.2	410	.....	Butte 1:49:55 } U.S.C.G.S.
246	Oct.	1	1 53 33	49	129	V	1 54 31	1 54 33.5	1 54 20.7	410	440 340	Butte 1:56:21 } epicentres.
247	Oct.	4	12 18 17	49 56	123 58	III	12 18 44	12 18 30.2	12 18 32.9	166	81 97	North of Seechelt Peninsula.
248	Oct.	4	.....	.....	.....	.....	.....	.....	12 47 15.0	.....	80	.....

†Station not operating.

TABLE 2—1952 EARTHQUAKES—*Concluded*

No.	Date	Origin Time GMT	Lat. N.	Long. W.	Intensity	Arrival Times of P-Phase, GMT			Distance			Remarks
						Victoria	Horseshoe Bay	Alberni	V	HB	A	
			° /	° /					kms			
249	Oct. 7					14 20 39						
250	Oct. 9							9 24 36.1				
251	Oct. 11							9 03 45.1				
252	Oct. 11		49.8	119.5	IV	10 06 12	10 06 12.5					Felt at Kelowna, B.C.
253	Oct. 12		47.2	123.3		17 06 24.2	17 06 38.3	17 06 41.7	78	173	199	Seattle 17:06:10. Washington State.
254	Oct. 14					21 51 26.0	21 51 34.8					East of Victoria in Washington.
255	Oct. 18							14 00 48.5				
256	Oct. 19							12 21 11.6				
257	Oct. 20					3 20 31	3 20 01.7					
258	Oct. 21							15 36 36.8				
259	Oct. 21	21 10 33.2	48 42	123 17	III	21 10 37.3	21 10 45.7	21 10 54.2	23	76	129	Gulf Island area.
260	Oct. 28	15 55 27	48 42	123 18	III	15 55 31	15 55 39.5	15 55 47.7	23	76	128	Gulf Island area.
261	Oct. 29					3 42 58						
262	Oct. 29					4 39 31						
263	Oct. 29					6 57 56	6 58 09	6 57 57				Off coast.
264	Oct. 29					7 10 10						
265	Oct. 29					9 35 21	9 35 31	9 35 21				Off coast.
266	Oct. 29					20 04 06		20 04 07				Probably near Nos. 263 and 265.
267	Oct. 31					19 12 11.6	19 12 28.3	19 12 29.9				
268	Oct. 31					19 12 54.2	19 13 11.0	19 13 12.4				
269	Oct. 31					19 14 09.0	19 14 25.6	19 14 26.8				Not seismic.
270	Oct. 31					19 20 50.0	19 21 05.6	19 21 07.4				
271	Oct. 31					19 21 49.5	19 22 05.0	19 22 06.5				
272	Oct. 31					19 22 56.5	19 23 12.6	19 23 14.5				
273	Nov. 10		47.6	121.9	IV	22 54 30.7	22 54 40.4	22 54 48.8				Seattle 22:54:14. Felt near North Bend, Washington.
274	Nov. 19		48 32	124 49	III	12 28 03.2	12 28 10.4	12 28 00.9	97	165	81	Entrance to Juan de Fuca Strait.
275	Nov. 20		48 54	123 56	III	21 31 42.8	21 31 45.2	21 31 45.7	57	74	73	East of Lake Cowichan.
276	Nov. 21					19 53 34.7	19 53 15.7					
277	Nov. 21					21 34 29.2	21 34 44.1	21 34 46.6				
278	Nov. 21					21 35 56.2	21 36 10.6	21 36 13.1				Not seismic.
279	Nov. 21					21 36 31.8	21 36 45.9	21 36 48.6				
280	Nov. 21					21 37 20.5	21 37 35.1	21 37 37.6				
281	Nov. 21					21 37 35.1						



282	Nov. 23	.....	.....	.....	.....	0 16 50.7	.....	00 16 51.1	.....	
283	Nov. 24	.....	.....	.....	I	23 17 46	23 17 24	23 17 38	.....	Readings doubtful.
284	Nov. 26	.....	50.0	124.0	II	6 30 21.2	6 31 03.8	6 31 09.1	.....	Jervis Inlet.
285	Dec. 8	.....	.....	.....	.....	16 41 17.8	.....	.....	.....	
286	Dec. 9	.....	.....	.....	.....	.....	.....	9 20 28.7	.....	
287	Dec. 9	.....	.....	.....	.....	19 37 59.5	19 38 12.0	19 38 07.5	.....	Not earthquake.
288	Dec. 10	.....	50.6	122.7	IV	13 55 19.0	13 55 07.8	13 55 16.2	281 145 212	Felt at Pioneer Mine, B.C.
289	Dec. 10	.....	.....	.....	.....	17 07 42.0	17 07 58.3	17 08 02.6	.....	Not earthquake.
290	Dec. 12	.....	.....	.....	.....	.....	.....	17 36 13.1	.....	
291	Dec. 16	.....	.....	.....	.....	5 43 40.9	.....	.....	.....	
292	Dec. 26	.....	.....	.....	.....	21 35 47.6	21 35 56.9	.....	.....	South of Victoria.



choices along the line of the valley since the epicentre lay to the east of all the stations. The felt region extends about one mile east and one mile west of the valley.

At Mission some woodpiles were reported to have been toppled, but on the field survey none could be found. No other damage was reported. Throughout the area it was reported that a noise like a rumbling truck accompanied the earthquake, and in Mission itself (rock at this point) one person thought a truck had struck the house. People were awakened by this noise along the valley. The noise and the tremor were not noticed north of Mission beyond the first plateau.

At Sumas an aftershock was reported on the following afternoon by one person, and this coincided with a small trace on the Horseshoe Bay record at 22:44 on February 7th.

TABLE 3

*Intensity III*

Mission, Matsqui, Abbotsford, Huntington, Sumas.

*Intensity II*

Hatzig, Hatzig Lake.

*Not Felt*

Haney, Steelhead, Ruskin.

*Victoria*

During 1952 several earthquakes were felt in the vicinity of Victoria. Contrary to some reports, none of these earthquakes did any damage.

There were three tremors in as many days on the 20th, 21st, and 22nd of February. The first (No. 100) was felt in Victoria and Sidney, B.C., at 19:07 GMT. The intensity was scarcely more than II on the scale. It was felt at the Observatory as the rumble of a truck. The smaller tremor (No. 102) on the next afternoon at 23:36 was felt generally, and again at the Observatory. At 9:39 on February 22nd many people in Victoria were awakened by the third and strongest tremor of this series (No. 103). It was felt at Sidney, Saltspring Island, San Juan Island, but not at Duncan, Nanaimo, or Vancouver. This earthquake and the next at 14:59 GMT on March 14th (No. 122) were felt in Alberni, and in fact alarmed many residents. That of March 14th was felt in Victoria as well as Jordan River, Port Angeles, Vancouver, and Saltspring Island but not Duncan or Nanaimo. These four tremors were located instrumentally under Haro Strait between Sidney and the International Border.

Tremors on April 11th at 9:49 (No. 138) and on May 19th at 18:36 (No. 166) were located on south-west Vancouver Island and south of Victoria in the Strait of Juan de Fuca respectively. Apparently in both cases the area around Jordan River felt the tremors more strongly than in the previous earthquakes for there was a request for information on the epicentre from the British Columbia Electric Company's office in order that they might decide on the wisdom of patrolling their power lines in that region. Although farther from Vancouver than the four previous shocks, the tremors were well pronounced in various parts of that city.

After the California earthquake in July, the Victoria local newspapers published a paragraph to the effect that the seismologist at the Observatory would welcome any

reports on local tremors. In a few days there were many telephone enquiries about rumblings that various residents thought were earthquakes. To date only one of these reports has led to the discovery of an earthquake, a very weak tremor on the Victoria records. That is No. 218 at 22:52 hours on August 11th. The tremor apparently was located just off the south end of the city. Similar disturbances (Nos. 194 and 195) were felt in Victoria on July 19th. Again the epicentre must be very close to the south-east coast of the island for the felt region is limited to a few streets.

#### *South-East British Columbia*

An earthquake (No. 131) whose epicentre has been placed by the United States Coast and Geodetic Survey on the east side of Flathead Lake in northwestern Montana, was felt in Canada. Questionnaires sent out after the tremor yielded the knowledge that the earthquake was felt at Fernie and Newgate in British Columbia. For this reason the earthquake is listed in the 1952 earthquakes. It occurred on April 1st at 00:38 hours GMT. Maximum intensity at the epicentre is given as VII on the Modified Mercalli Scale.

#### *Hope*

Along the Fraser River Canyon in the region of Hope and Yale a sharp tremor (No. 187) was felt at 22:55 hours on July 4th. The list of centres where this earthquake was felt is given in Table 4. Province of British Columbia highway construction crews felt the tremor between Hope and Spuzzum and noticed some boulders set into motion by the vibrations. A flour sack was reported overturned at Hope.

It appears that the earthquake was not felt east of the Fraser River, nor south of Hope. The instrumental epicentre is in the mountain region west of Yale, so the two facts put together seem to fix the epicentre between Harrison Lake and the Fraser River. There is one isolated centre, Abbotsford, where two people felt the tremor whereas communities closer to the epicentre felt nothing. This would seem to indicate that the Mission tremor was actually at the north end of the valley near Mission, and Abbotsford, reporting a strong intensity, did so because of local conditions.

A second tremor six minutes later was felt generally around Hope, Yale, and Spuzzum.

TABLE 4

Place	Intensity	Place	Intensity
Yale	IV	Chilliwack	0
Hope	IV	Princeton	0
Spuzzum	III	Abbotsford	II
North Bend	III	Mission	0
Lytton	0	Agassiz	0

#### *Powell River*

An earthquake (No. 190) was reported by a few persons at Powell River on July 15th at 10:09 hours GMT. No other centre appears to have felt the tremor, although a good record was obtained on the seismograms.

*Kelowna*

Questionnaire forms, distributed in the area after an earthquake reported from Kelowna on October 11th (No. 252) show that two isolated centres felt the tremor quite strongly. However, places between or near Kelowna and Grand Forks reported no disturbance at all. It is quite possible that the epicentre was nearer Kelowna for the Horseshoe Bay and Victoria records indicated that source. The intensity rating for either of these centres was less than III. Alberni did not record the earthquake.

*Pioneer Mine*

A tremor (No. 288) which registered slightly at Butte, Montana, awakened persons in Pioneer Mine and Birken, B.C. at 13:55 GMT, December 10. No damage has been reported. Records were strong at all three stations in the network. The felt area would appear to be elliptical in shape with the major axis in a north-west direction, as neither Pemberton nor Seton Lake reported a tremor.

## DISCUSSION OF EPICENTRES

While it is still too early to draw any final conclusions from the location of epicentres, it is interesting to combine the data obtained to date on a single map. This has been done for the southern part of Vancouver Island on the map of Figure 2. The map also shows the location of some known faults. These have been taken from a paper by Clapp.<sup>2</sup>

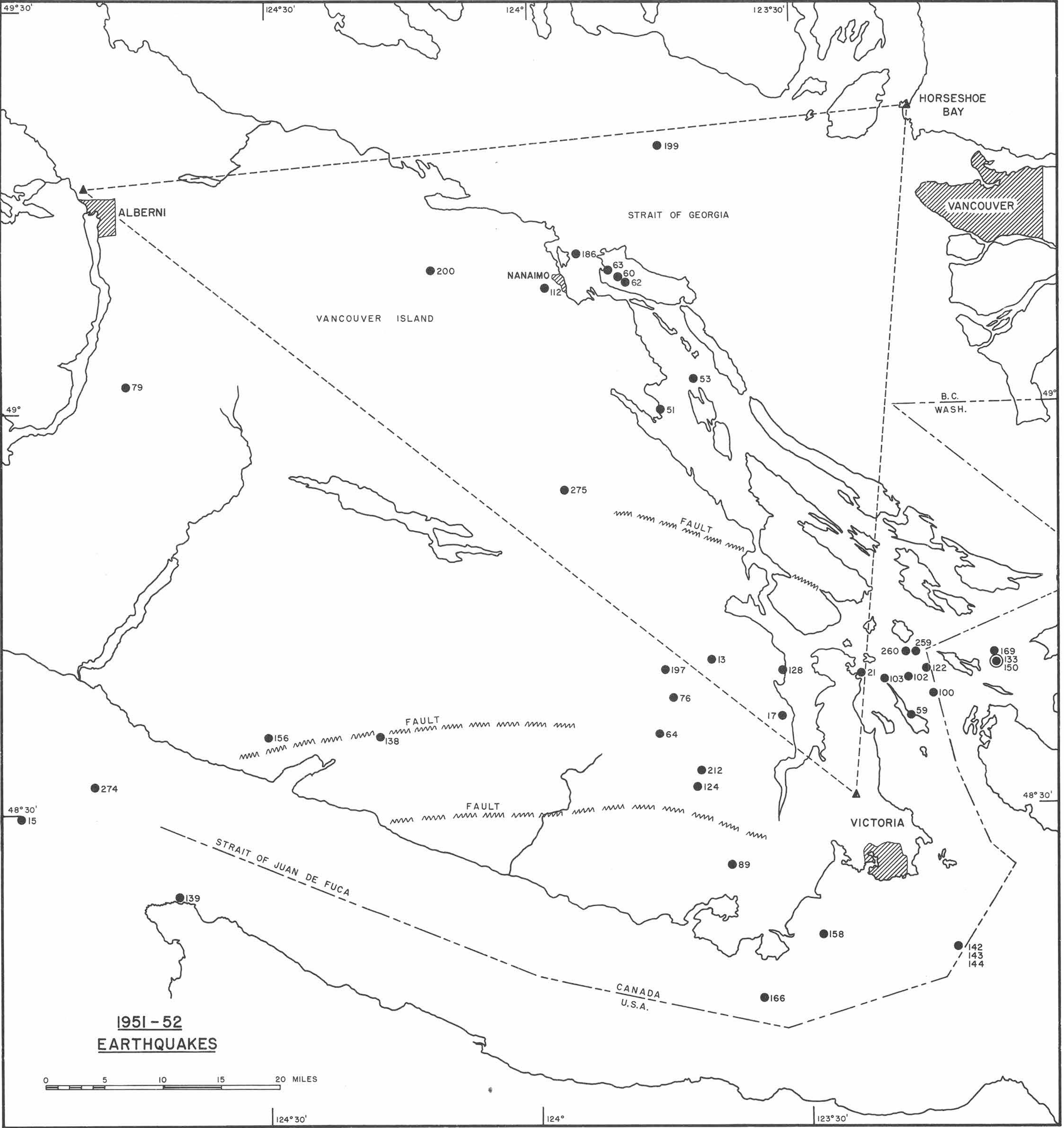
Examination of the figure seems to give some indications of correlation between epicentres 15, 274, 156, 138 and 64 and a known fault. A second well-defined line seems to pass northwestward from epicentres 166 to 197; it might possibly be extended still farther north through epicentres 275 and 200. These patterns may of course have no significance whatever, but they at least suggest that regularities in the arrangement of epicentres may eventually emerge.

An outstanding feature about epicentres in the southern part of the island is that they are usually felt strongly in Alberni, although Duncan and Nanaimo, which are frequently closer to the epicentres, report no notice of the earthquakes. Residents of Alberni continue to be disturbed by each event. Alberni is in a valley almost totally surrounded by sedimentary rocks forming mountains. In the valley itself are one or more outcroppings of volcanic rocks. During the 1946 earthquake considerable damage was reported from Alberni although the epicentre was on the other coast of the island.

The epicentres at Mission, at Hope, at Kelowna, and at Pioneer Mine appear to be isolated events to date. Perhaps such can be expected in the mountainous interior of British Columbia. It would not be surprising if there were minor tremors in that area of British Columbia along the continental divide north of Montana. The Montana seismologists report epicentres up to the border, and it seems reasonable to expect that similar disturbances would be detected farther north. In fact, although no record was obtained, it seems certain that the Banff area was shaken by a tremor on March 3rd.

Again as in the past there were several tremors, apparently along the continental shelf as far west as 129°. These are well recorded on the instruments but because more

<sup>2</sup> Charles H. Clapp, "Geology of the Victoria and Saanich Map Areas, Vancouver Island, B.C.", *Geological Survey of Canada*, Memoir No. 36, 1913.









westerly control is lacking the epicentres are approximate only. Along the west coast of Vancouver Island several small tremors have been located, but not in sufficient number to indicate any trend in direction. A few scattered earthquakes (very small) were centred south of Alberni.

Around Nanaimo, both west of the city on the island and east in the Gulf of Georgia, there are several good locations. These earthquakes are not reported as felt by anyone in the area, although some are quite sharp. Towards Powell River there are more epicentres than in 1951, one of them (July 15) having been felt.

The instruments record from time to time earthquakes in Washington State, but no precise location is given on the map. Arrival times are listed in Table 2 for reference by other seismologists. One tremor in the Queen Charlotte Islands area was well recorded at all stations although the distance involved is greater than the range in which the Willmore-Sharpe instruments were expected to operate.

During 1952 seismological reports have been received from Butte, Montana, and from Seattle, Wash. In some cases the readings from these stations have been used to determine epicentres. Such an exchange of information can be very beneficial to all stations concerned.

Dominion Astrophysical Observatory,  
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