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ON THE LOCAL EARTHQUAKES IN FINLAND

by

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Abstract

The seismicity of northern Finland is investigated on the basis of the records of the Sodankylä station, which contain over 800 shocks that have occurred at distances smaller than 5° during three and a half years. Only a fraction of these can be localized, but it seems evident that weak shocks are occurring in the northern Kainuu region at a rate of 10 to 20 per year. Detailed information about some stronger shocks is given.

1. *Introduction*

According to the macroseismic investigations of RENQVIST [1, 2], the seismic activity of Finland is low. The map compiled by RENQVIST indicates the highest activity in the region of Kuusamo, where one shock is felt on the average every three years. In southern Finland the activity is lowest, and only 0—1 shocks are felt every hundred years. The highest intensity observed corresponds to VI in the Mercalli-Cancani-Sieberg scale, but most of the shocks only attain intensities III—IV.

The Helsinki seismograph station was established and equipped with Mainka seismographs in 1924, but as these instruments are not suited for recording small local shocks, the macroseismic method remained the only means for studying them until 1956. The results of this early period deserve special interest, however, and they have yielded im-

portant information about the spatial and temporal distribution of the shocks.

Before the IGY, another seismograph station was established in connexion with the Geophysical Observatory in Sodankylä in June 1956. It was equipped with a Benioff vertical seismograph and one year later also with two shortperiod Nurmia horizontal seismographs [1]. During spring 1957, the Helsinki station was also furnished with short-period instruments.

A third station was established on the premises of the Nurmijärvi Geophysical Observatory in December, 1958, employing short-period Nurmia vertical and horizontal instruments. In December, 1959, an experimental station employing a vertical instrument only was set up in Oulu.

Thus the network of seismograph stations in Finland is still much too sparse and has been in operation for too short a time to give detailed information about the seismic activity of Finland. It is evident, however, that the regions described by RENQVIST as the most active also exhibit the greatest microseismic activity. This emphasizes the need for a third seismograph station in northern Finland to facilitate exact localization of the shocks, most of which are so weak that they are not recorded at the stations in southern Finland. The present investigation is based on the Sodankylä recordings, as it was the only station in the North until the end of 1959.

2. *The Distribution of the Shocks*

During its three and a half years of operation, the Sodankylä station has recorded over 800 shocks that have occurred at distances of less than 5°. The first report about these shocks was published in April, 1958 (PORKKA and VESANEN, [4]; VESANEN and PORKKA, [7]; VESANEN, PORKKA and NURMIA, [8]). This report concerned 91 shocks with epicentral distances under 5° that took place between August 1, 1956, and June 30, 1957, and in addition there were many cases where the S-phase alone was recorded. However, most of these 91 shocks took place outside Finland, either in northern Sweden and Norway or in the U.S.S.R. A typical feature was that the shocks often occurred as a series lasting for several hours.

Since the beginning of the IGY, the Sodankylä station has recorded a total of 742 shocks with epicentral distances under 5° during the time from July 1, 1957, to December 31, 1959. The accompanying Table 1

Table 1.

	1956	1957	1958	1959
Jan		4	21	25
Feb		1	31	22
Mar		—	47	32
Apr		7	33	47
May		6	38	24
June		9	26	12
July	—	23	34	29
Aug	10	29	30	24
Sept	29	10	18	24
Oct	13	16	13	18
Nov	4	21	18	19
Dec	8	14	17	27
	64	140	326	303

Table 2.

$\Delta°$		$\Delta°$	
0.1—0.8	2	2.9—3.0	26
0.9—1.0	3	3.1—3.2	61
1.1—1.2	9	3.3—3.4	49
1.3—1.4	4	3.5—3.6	32
1.5—1.6	11	3.7—3.8	11
1.7—1.8	15	3.9—4.0	17
1.9—2.0	14	4.1—4.2	3
2.1—2.2	28	4.3—4.4	2
2.3—2.4	116	4.5—4.6	5
2.5—2.6	218	4.7—4.8	—
2.7—2.8	115	4.9—5.0	1
	535		207

gives the number of shocks observed in each month from August, 1956. Table 2 gives the distribution of the above-mentioned 742 shocks according to epicentral distance.

Over 50 of these shocks have also been recorded at the Kiruna (Sweden) or Apatity (U.S.S.R.) stations. A comparison of these results indicates that most of the shocks have occurred in the U.S.S.R, although there remains an ambiguity in cases where records are only available from two stations.

In all, 67 shocks have been recorded at both Sodankylä and Apatity, and the epicenters of all these are definitely in the U.S.S.R. Nine shocks

have been recorded at both Kiruna and Sodankylä, and these have occurred either in Finland or in the Kola peninsula between Kantalahti and Petsamo. No macroseismic observations are known, and the assumed epicenters are located in areas where, according to RENQVIST, only 8 to 11 shocks take place on 100 years. The origin times, distances from Sodankylä and Kiruna, and the location of the intercept within Finnish territory are given in Table 3.

Table 3

Datum	Time (GMT)	$\Delta°$		Epicentrum
		From Sod.	From Kiruna	
1958 7. 8.	15 01 32	2.4	4.0	Puolanka
1959 11. 2.	22 39 04	2.4	4.5	Kiantajärvi
14. 2.	14 43 35	2.4	4.3	Kiantajärvi
2. 3.	22 16 06	2.5	4.2	Puolanka
1. 4.	17 30 37	2.9	4.6	Ristijärvi
4. 4.	14 31 30	2.6	4.0	Utajärvi
6. 4.	14 30 32	2.1	4.0	Taivalkoski
12. 4.	20 28 58	2.9	4.6	Ristijärvi
28. 4.	16 30 45	2.5	4.3	Kiantajärvi

In addition, twelve of the shocks have definitely occurred in Sweden or Norway.

Only six shocks were registered at three or more stations, and these have all occurred in the Kola peninsula, U.S.S.R. There thus remain only the shocks with epicentral distances of less than 1.9 from Sodankylä which have certainly occurred in Finland, and 36 such shocks have been recorded in the three and a halft years. All of these have been so weak, however, that they have not been recorded at other stations, nor are any macroseismic observations known.

On December 24, 1956, a relatively strong earthquake (III — Intensity — IV) occurred in Ranua, and macroseismic observations are available from an area of 7500 km² (PORKKA and VESANEN, [3]). On December 8, 1958, the Sodankylä and Kiruna stations made the following observations:

Sod	iPg	16—07—03
	iSg	—18
	Δ:1.2°	
	H:	16—06—39
Ki	Sg	16—07—23

These give an intercept at Pajala, Kolari, whereas a strong shock was felt at Rauhala, Kittilä. Another rather intense earthquake took place on February 20, 1960, in the border region of Kuusamo, Salla, and Posio counties north of Maaninkavaara. The instrumental epicenter is 66.5° N, 28.4° E (PENTTILÄ, [2]).

This shock likewise resulted in macroseismic observations from a large area. The Ranua shock took place in an area where the earthquake frequency according to RENQVIST is 12—15 shocks per 100 years. The Kuusamo shock occurred in RENQVIST's region of 5—7 shocks per 100 years.

In addition, two weak shocks have localized in the northern part of the Gulf of Bothnia on the basis of the Swedish and Finnish observations. The origin times and coordinates are as follows:

July 2, 1957 09—17—06; 62.°8 N, 20.°8 E
Feb. 25, 1958 09—18—22; 62°.25 N, 20°.0 E

3. *Conclusions*

It is not yet possible to arrive at final conclusions regarding the seismic activity of Finland, for the period during which the sensitive instruments have been available is still too short. It seems evident, however, that the northern Kainuu region exhibits the highest activity on the basis of the microseismic data. Very weak shocks occur at a rate of 10 to 20 per year, and during the last three and a half years two stronger shocks that have also yielded marcroseismic observations have taken place. Neither of these, however, occurred within RENQVIST's region of highest seismic activity.

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