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Department of Mines and Resources  
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Dominion Observatory

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SEISMIC RESEARCH PROGRAM  
ROCK BURST PROBLEM  
LAKE SHORE MINES

Intensive Seismic Program  
Report No. 1  
March 26 - May 1  
1945

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Ernest A. Hodgson

**RESERVE/RÉSERVÉ**

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POUR LA CONSULTATION SUR PLACE**

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**Ernest A. Hodgson**

OTTAWA



INTENSIVE SEISMIC PROGRAM  
LAKE SHORE MINES, KIRKLAND LAKE  
4702E - 4802E  
Nos. 1-30; March 26 - May 1, 1945  
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The regular seismic program, carried out systematically since about July, 1943, in a block of ground from 4500E to 4800E, as outlined in Report No. 12, has failed to afford prediction for any bursts experienced in that part of the mine up to January 1, 1945, and indeed to date. It is to be noted, however, that such bursts as have occurred have been relatively small and that nearly all have coincided with the blasting. In no instance has there been a clear case where a geophone had been installed close to a burst and indicated a warning activity. Three very pertinent questions arise:

1. Is there a crudescence of subaudible snapping as rock pressures become acute?
2. If so, do they appear soon enough to provide a useful warning of a burst?
3. Further, if they occur, how close to such stressed ground must a geophone be placed to record the warning activity?

A series of laboratory experiments performed by Dr. Obert and his associates and reported by the writer give a definite affirmative answer to the first two of these questions for the case of small rock specimens. But it becomes desirable to determine whether these laws would hold for the rocks in the mine and, in particular, under the unique conditions existing in Lake Shore Mines.

To do this and, at the same time, to eliminate all question as to the effective distance within which a geophone must be placed, it was decided to select a block of ground in the mine, known to be under conditions of serious pressure, to drill in it a multiplicity of closely-spaced holes and to record from a selected number of geophones located in these holes and switched on at intervals,—an intensive seismic program.

The installation difficulties have been overcome and the first month of full-scale recording has been completed. Partial recording was carried out since about the middle of January, making use of every facility as it became available.

The details of the work are being outlined in full in Report No. 14, now in the course of preparation, but are indicated sufficiently for present purposes in the descriptive legend on the left of each of the 31 daily records submitted herewith. (These are the same as to text on each of the photographs but will be found to be more legible in those covering the last days of April, when printed sheets were used instead of the special-size typewriting.) On the right of each photograph are given the data pertaining to that particular day. The present discussion is merely a running commentary on the daily record-photographs. These are numbered consecutively for convenient assembling, but are left unbound so that they may be handled freely while reading the text.

Remembering that this program is a special effort to obtain definite answers to the three questions stated above, we may first observe that on only three occasions over the period covered by this report was there a burst anywhere near the section concerned, during recording hours.

The record of the first of these is shown on plate 3 where a small burst is registered at A near the centre of the upper strip of record. Evidently there was ample high incidence of snapping prior to the burst. The upper line of the top pair shows the recording from H71. The lower line is that from H96. The latter is in the hanging-wall on 4802E about 75 ft. farther east than H71, which is in the footwall on 4702E. Note the difference in recording for these holes which are less than 150 ft. apart.

The next case occurs in the lower (A.M.) part of No. 15 (April 13-14). The writer was on 4700 very soon after 3:30 a.m. on April 14. The counts were high on H62 (4502E4) and H56 (4701E4) of the old program. By 5 a.m. they had become very high, especially on H62. A strain burst occurred at about 5:02 a.m. It seemed to be above 4700. The count on H62 had gone up to over 100 c.p.m. shortly before

this burst and stayed high afterwards. It died down somewhat but was again becoming noticeably very high by about 5:39. A more severe strain burst then occurred which, though it shook things up a bit on 4700 seemed definitely to originate above that level. It is believed that the locus of all this activity lay near H62 in 4502E4.

These bursts both happened to occur on the check (central) geophones in the new program. They are shown at the points A and B on photograph No. 15. In the case of the first one, the geophones in service just preceding the burst were, successively, H83 and H82 on 4702E and H97 and H95 on 4802E (strips C and D), — toward the east of the geophone recording the burst, while the ones immediately afterwards were, successively, H72 and H73 on 4702E and H91 and H92 on 4802E (strips E and F), — to the west of the geophone recording the burst. Evidently the snaps recorded much better toward the west of the layout.

Considering the second burst, we note that the geophone-strip preceding that of the burst is made by H70 and H90 (strip G) recording from the extreme west end of the layout on each of the two levels, while that immediately following is from H86 and H101 (strip H) recording from the extreme east end. Strips K and L are also from the east end, while M, N and O are from toward the west. Again we note that recorded activity is confined to the west end of the layout.

Remembering that the upper record of every strip is from 4702E and the lower record from 4802E, it is to be noted that the activity was more marked on 4700 than on 4800. This is in keeping with the evidence obtained from H62 in the old program and with the writer's observations made while listening at the time of the bursts on 4700, i.e. all confirm the deduction that the centre of each of the two bursts on April 14 was above the 4700'-level.

With regard to our main object (obtaining definite answers to our three tabulated questions), it is concluded that:

- (1) Three strain bursts occurred during April which

afforded a limited opportunity for study. None of these was centred within the block of ground directly serviced by the special program.

- (2) There was definite prediction for at least twenty minutes to half an hour before the bursts.
- (3) Geophones on the west end of the layout for both 4700 and 4800 seem to be in more active ground than those on the east end.
- (4) A distance of only 150 ft. is sufficient to prevent full registration of high counts while a distance of 300 ft. seems to suppress them altogether.
- (5) In connection with the deductions (3) and (4) it is to be noted that further study is required. Some holes may be in poor ground and/or may be serviced by geophones of lower efficiency than others which would account for individual low records (unless at some times these were high). Furthermore, whole groups of geophones may be cut off by a fault plane from the active ground. It would seem that some such fault cuts off the east end of the layout from the west end on both levels.

#### General Notes on the Recordings

The P.M. part of the records is always more or less disturbed by mine noises some of which are identified below, together with some general notes as follows:

<u>Plate</u>	<u>Iden.</u>	<u>Cause</u>
1	A...	Blasting rounds.
1	B...	Skip filling.
1	C...	Crusher.
1	D...	Sensitivity tests by observer.
2	A...	Blasting.
3	A	Strain burst.
4	A...	Pencilled notes made during the listening.
4	B...	Rock runs.



<u>Plate</u>	<u>Iden.</u>	<u>Cause</u>
6A	A	No recording is attempted on Saturday afternoons as there is too much interruption by work activity.
8	A...	Drills. The time switch was out by 4 hrs. due to power interruption so the P.M. part of the record was made while mining was going on. The clocks were corrected when Hodgson reached 4700 about 3:50 a.m. April 4.
8	B...	Blasting.
9	A...	Small salvos.
11	A...	Some fan or pump which was not identified and which may have been operating in Wright-Hargreaves since it affects only the east end geophones. See also plate 13.
17	A...	Tapper tests local to 3AB put on after each change of the switch by operator while listening, checking every geophone in an hour.
17	B	A typical blasting round which occurs every morning though no work is supposed to be in progress in LSM. or adjacent workings. See also A on plate 18 and (unmarked) on nearly all A.M. recordings.

Other general notes, explaining irregularities in recording will be found endorsed in the record data spaces to the lower right of some of the plates.

Notes on the Recording during April

- (1) During the early part of the month there was a good deal of interference from power interruptions. As the entire program is synchronized

and operated with synchronous motors, any interruption to the main program clock will transfer the recording hours into shift time and any interruption to one or more of the time switches and not to others will upset the program correlation. To set the time switches on 4700 is simple when the operator arrives there but to correct those on 4500 and 4800 required a special trip to each of these levels. To overcome this difficulty cut-out relays have been installed on 4500 and 4800, operated from 4700, which enable the observer to correct all switches, for both the old program and the new, from the doghouse on 4700.

- (2) There were other interruptions to recording as noted on the plates. The omission of Saturday afternoon recording is a regular procedure, taken care of by a special program clock.
- (3) The sill above stope 4902E was being reduced during the latter half of April. It was cut through into 4802 on April 26. The heavy concussion opened the main switch in the doghouse on 4700 so that the records are missing for April 26-27. Note (plate 27) that activity was still high on the P.M. recording on April 27 but had died by the A.M. recording of April 28.
- (4) Knowing that the sill was to be blasted out and that it was quite possible that the timber would go in 4802 and possibly cut the lines to the switch on 4802E4, it was necessary to provide a special thermal cut-out in case the A. C. fuse did not blow. This cut-out was designed and made by Gibbs and was installed by Hallick on April 21. See notes on plates 21-22-23. The necessary adjustments were made on April 22 since when the device has given no trouble. Incidentally, when the sill was blasted, the timber did not fail and the lines were not damaged.
- (5) During the latter part of the month there was



some interruption due to the stylus points carbonizing and breaking short. See, for example, plate 25 toward the end of the P.M. recording on the upper (4700) side. See also plate 30.

- (6) The printed legend slips (on the left side of the plates) were used on and after plate 25.
- (7) Except for the strain bursts on plates 3 and 15 and the activity due to the removal of the sill still showing on plate 27, there has been very little more than moderate normal activity in this section of ground during the month.

*at base of slope 4922 E.*

Dominion Observatory,  
May 16, 1945.

Ernest A. Hodgson

