Seismic Research Program
Rock Burst Problems
Lake Shore Mines

Report No 7
Surface Seismograph Records
1941

16741 E. A. Hodgson DOM. OBS.

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Department of Mines and Resources
Surveys and Engineering Branch

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Dominion Observatory

SEISMIC RESEARCH PROGRAM
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The six previous reports of the above indicated series bring the general account of the rock burst research program to the end of June, 1941. Report No. 8, now in preparation, will carry forward that general account. Report No. 4 dealt entirely with the records of the surface seismograph from the date of its installation, Dec. 19, 1939, to the end of 1940. The series for the year 1941 is here presented. The instrument operated practically continuously throughout the year, the records being numbered 197-574 inclusive. The usual report arrangement is again followed: a summary discussion of the year's recording, followed by more detailed reports on a few special points and concluding with the tabulated data.

1. Summary Discussion: The seismograph and the auxiliary equipment were modified considerably during 1940, resulting in a recording time loss (as defined in Table I) of 6.14 per cent. Few changes were made in 1941 and those, such as they were, did not seriously interrupt the recording. The time loss in 1941 has been only 3.08 per cent. At no time was the time correction unknown and for most of the year the adjusted corrections were classed as A, i.e. dependable to within ±.5 sec. This is very satisfactory. As a result it may be said that, except for the time losses set forth in Table I, the check on the rock bursts at Lake Shore has been continuous and adequate. It is known, moreover, that no burst of any importance occurred during any of the various interruptions to service.

Only one burst (that of July 30, listed as No. 255C) was of sufficient magnitude to register on the Benioff seismograph at Ottawa. The data obtained will permit a fairly precise determination of seismic propagation time to Ottawa and a less accurate value to Shawinigan Falls. The burst was not registered at Seven Falls nor at any of the New England stations. A publication on this subject is now in the course of preparation.

The correlation of mine data and instrument records for 1941 has been most satisfactory. The detailed reports on all bursts in Lake Shore Mines were made available regularly to the writer as well as to those working at Kirkland Lake. The correlation has been done with painstaking care by Mr. O. E. Andrew of the Lake Shore staff. As a result the seismograms have been subjected to close scrutiny throughout the year. It is interesting to note that, in some cases, bursts are reported in the Lake Shore lists which are not registered on the seismograph; while others, not listed, appear on the records.

The first group, those listed but not registered by the surface seismograph, include more or less important rock falls with or without slight shocks to start them. It is readily understandable that, during the off-shift

periods (in general from 3 a.m. to 7 a.m. and from 3 p.m. to 7 p.m.), the blasting immediately preceding may have loosened some rock masses and that very slight bursts may suffice to cause rock falls of several tons of loose. Such slight strain bursts may not release sufficient energy to register on the surface seismograph approximately a quarter of a mile distant.

The second group, those registered but not listed, are usually more severe. They occur in abandoned workings of Lake Shore Mines or in adjacent mines. A few of them are identified as having occurred in other mines but no regular reports from these mines are available. Should such a burst at any time be of sufficient magnitude to register at Ottawa, it could, no doubt, be definitely located and the data used for velocity determinations. In the meantime, the surface seismograms indicate all of these relatively severe releases of energy and provide a complete record of the burst activity in the vicinity of the installation. The records are of sufficient value to warrant a recommendation that they be continued at their present efficient standard throughout 1942.

2. Modifications of Seismograph or Auxiliary Equipment: About March 18, a test was run comparing the surface seismometer with that used underground (Heiland geophones Nos. 331 and 357, respectively). It was suspected that the former was lacking in sensitivity. This proved to be the case and the trouble was found to be due to friction. The difficulty was corrected and an increased sensitivity may be noted beginning with record No. 275. It is to be remembered, however, that the instrument was not at any time so lacking in sensitivity that it would not have given a good timing record of any large burst had one occurred.

During the same period (March 15-23) a change was made in the time-marking device. The screen on the cylindrical lens was removed and the timing semaphore set to almost eclipse the strong light spot. It was arranged also to have the semaphore move in such a manner that the timing marks were all above the normal zero line and the bursts registered below. It is thus possible to put on as many timing or signal marks as desired without interfering with the recording of bursts.

On March 17, the chronometer was encased in a specially constructed wooden box mounted on a wall bracket. The installation was arranged in such a way that the extra, hinged bottom of the box could be dropped down and the chronometer wound without any chance of a twisting motion being given which would cause the escapement to lose a beat. The box also protects the chronometer from jarring and reduces the temperature effects. The time comparisons showed a marked improvement in chronometer rate after this change. A detailed account of the three above changes in set-up is given on pp. 6-7 and in Fig. 15 of Report No. 5.

On July 11, the Dent chronometer was sent to Ottawa for cleaning and adjustment. It was replaced during this period with a substitute (Nardin No. 1144) sent for the purpose. The original chronometer was again placed in service on July 20 and showed an excellent rate thereafter.

In June, Mr. Gibbs constructed a re-designed time-recording relay for the automatic signals. This proved to be much more sensitive than the one previously in use and

has greatly improved the recording of radio time signals. A re-wiring of the aerial lead-in at this time has also helped to improve the reception.

On August 5, Mr. Gibbs installed a testing device on the seismograph. A small lever inside the top of the aluminum case holds a small test mass away from the suspended coil. On completing an electric circuit a magnet mounted outside the top raises one end of the lever and deposits the mass on the coil. It is left on for a few seconds until the system comes to rest and is then lifted by gravity (due to the heavy arm of the lever being on the side away from the mass) on the opening of the circuit. Beginning with record No. 425, tests have been put on the record each day just before removing a sheet and just after putting a new sheet in service. This device has proved of the greatest value in proving the continued sensitivity of the seismograph, even when blasting fails to show for some days. On one occasion (see records Nos. 425-428) the tester revealed friction in the seismometer and led to its being removed promptly.

At first it was found that the wide excursion of the light spot on the application of the test mass failed to show clearly. The photographic paper was supposed to be developed only two minutes. Mr. Gibbs experimented with various longer times and found that three to four minutes development greatly improved the test offsets and also the burst records. The slightly greater fogging of the sheet does not interfere with the record. The results are very much better. Accordingly, the longer development time has been adopted as standard.

On June 5, Mr. Frank Hallick was appointed to assist Mr. Gibbs. He was given charge of the surface seismograph as a routine duty. The character of the records bears testimony to the competent and careful attention he has given the installation since that time.

3. Lost Time: The importance of maintaining the surface seismograph in continuous, efficient operation was emphasized in Report No. 4. An analysis of the time lost during 1941 has been prepared on exactly the same basis as was there described. This appears as Table I. It will be noted that there has been a marked improvement over the first report, the lost time being reduced from 6.14 to 3.08 per cent.

This is not altogether due to the fact that there were fewer adjustments to equipment. A determined effort was made to reduce the figures and it has been markedly successful. Mr. Gibbs has arranged a schedule which reduces the time lost during the changing of records to one or two minutes as a rule.

A further marked reduction would result if automatic signals were installed to warn of the failure of the light source, the time lost from all such failures in 1941 being 5866 min. Had all light-source losses been completely avoided, the lost time for the year would have been reduced to 1.96 per cent. It would be comparatively simple to instal a buzzer or lamp to warn when the source light failed from any cause.

4. Chronometer Corrections: The chronometer corrections have been determined as outlined in Section 3 of Report No. 4.

Table II of this report shows the chronometer correction, as determined from the rate graph, for 12 o'clock noon E.S.T. each day. Where the observed corrections were determined with a consistency which would warrant the assumption that the error in the tabulated corrections is less than ±.5 sec., the letter A is appended. Where the final corrections are apparently correct to about half a second the letter B appears, and where they are less valuable the letter C.

The corrections as read from the graph are given to tenths of seconds. In using them, one may interpolate to the required epoch and obtain a correction expressed to tenths of seconds. This will permit the exercise of a certain amount of judgment when scaling the time of an event and applying the correction; but the final result should never be quoted to a closer approximation than half a second.

The automatic signals are much better for 1941 than they were for the previous year as will be noted on checking over the valuation letters A B C. A violent magnetic storm about Sept. 17 and others less violent from time to time interfered with the signal but it was taken at sufficiently close intervals to give good rate graphs. A total of 266 comparisons throughout the year were found sufficiently good to be used for this purpose. The percentage of usable signals was much higher after Mr. Gibbs installed the new automatic relay in June.

While the signals are much better than before, the causes of variation in the clock rate, as shown by the underlines in Table II, could be determined and perhaps reduced or eliminated if the corrections were evaluated and plotted day by day at Kirkland Lake. When plotted in arrears at Ottawa, the fact of the change can be determined but not the cause. There results a slightly greater uncertainty at the point where the adjoining different rates meet. One does not know at exactly what point to indicate a change in rate.

On several occasions the chronometer seems definitely to have lost a second or more superposed on its regular rate. One such case is indicated for record No. 218. Another, less marked, occurred between records Nos. 344 and 345. A marked loss occurred between records Nos. 433 and 434. A minor difficulty was experienced with the graph between records Nos. 446 and 447. The correction is somewhat uncertain between Oct. 10 and Oct. 12. The more marked of these anomalies in the graph were possibly due to winding the chronometer in such a manner as to make it lose a beat or more of the escapement. In every case the chronometer lost by a small amount.

5. Distribution of Bursts: The continuity and uniformity of recording in 1941 was very much better than during the previous year. The modifications of equipment were not such as to affect the sensitivity of the seismograph. The installation of the testing device on Aug. 4 provides a check on the uniformity for the remaining part of the year. Till then, the recording of the daily blasting is the only proof of continued sensitivity. The evidence is good, however, that all bursts of sufficient intensity to be of any interest in this investigation were registered.

As previously noted, some bursts as reported from the mine were not registered on the surface seismograph and vice versa. The mine seismograph was not operating the entire

year. When its records were available they were scanned in conjunction with those of the surface instrument and the mine reports. Some, but not all, of the bursts reported but not registered at the surface were found to have been registered on the mine seismograph. A graphical presentation of the mine records, prepared and furnished by Mr. O. E. Andrew, is given in this report just before Table I.

The mine reports have been set out in Table IV. The reports as furnished are given in much greater detail but it was felt that sufficient information has been selected from them for this report. An explanation is given on the reverse of the title page for that table.

The records of the surface seismograph have been set out in Table V. An explanation is given on the reverse of the title page for that table.

In all, seventy-seven (77) bursts were reported by the mine. Of these we find that:

(a) 50 were certainly recorded by the surface seismograph
(b) 19 were certainly not " " " " "
(c) 5 may have been recorded but it is not certain
(d) 1 could not have recorded, for the seismograph was not in operation at the time
(e) 2 may have failed to record because the seismograph was not in operation.

Of the nineteen (19) which yielded no trace, only three (3) were in the more distant (eastern) end of the mine. In addition, the recording of one other burst which occurred in that side is open to question. It does not appear, then, that the greater distance is a serious factor in the explanation for non-recording of some reported bursts. Of the seventy-seven (77) bursts reported, twenty (20) occurred in the eastern side of the mine.

Let us divide the records on the seismograph into four categories on the basis of the range of half-amplitudes as measured in half-millimeters, as follows:

A = up to 10 B = 11-20 C = 21-30 D = over 30

Examining the fifty (50) reported bursts which were certainly recorded we find their records fall into these four groups as follows:

A	B	C	D
12	15	5	18

If we analyse all the records of Table V by months we find that they fall into these categories as follows:

	A	B	C	D	Total
Jan.	15	3	2	1	21
Feb.	9	6	3	2	20
March	7	7	2	2	18
April	6	14	4	3	27
May	7	6	5	0	18
June	12	11	3	0	26
July	29	10	9	0	48
Aug.	9	9	2	5	25
Sept.	16	10	0	6	32

(Cont'd)

	A	B	C	D	Total
Oct.	17	15	1	9	42
Nov.	6	6	1	8	21
Dec.	1	4	0	3	8
Total	134	101	32	39	306

There is a noticeable increase in the number of the largest bursts (in category D) after August 1. After November 17, when the miners went on strike and production was curtailed, the number in this category, for the remaining part of November, was only two (2) and, for December, three (3). All categories fall off noticeably after November 17.

The total number of bursts reported by the mine and/or recorded on the surface seismograph in 1941 is thus about 325. If we deduct most of those of the first category (many of which are of the order of the largest blasts) we may say that at least 200 bursts of considerable intensity occurred during the year. As pointed out elsewhere, it does not follow that all of these occurred in Lake Shore Mines. Indeed it is known in a few cases that they did not. Only two bursts were of sufficient intensity to record at Ottawa. A publication dealing with these is now being prepared.

6. Suggestions for Improvement of Service: The service has been so good during 1941 that one hesitates to list suggestions for improvement. However, in addition to the list of suggestions given last year, which were, in general, noted and adopted, we may suggest that:

(a) The operator should read and avoid when possible the sources of lost time in 1940-1941.

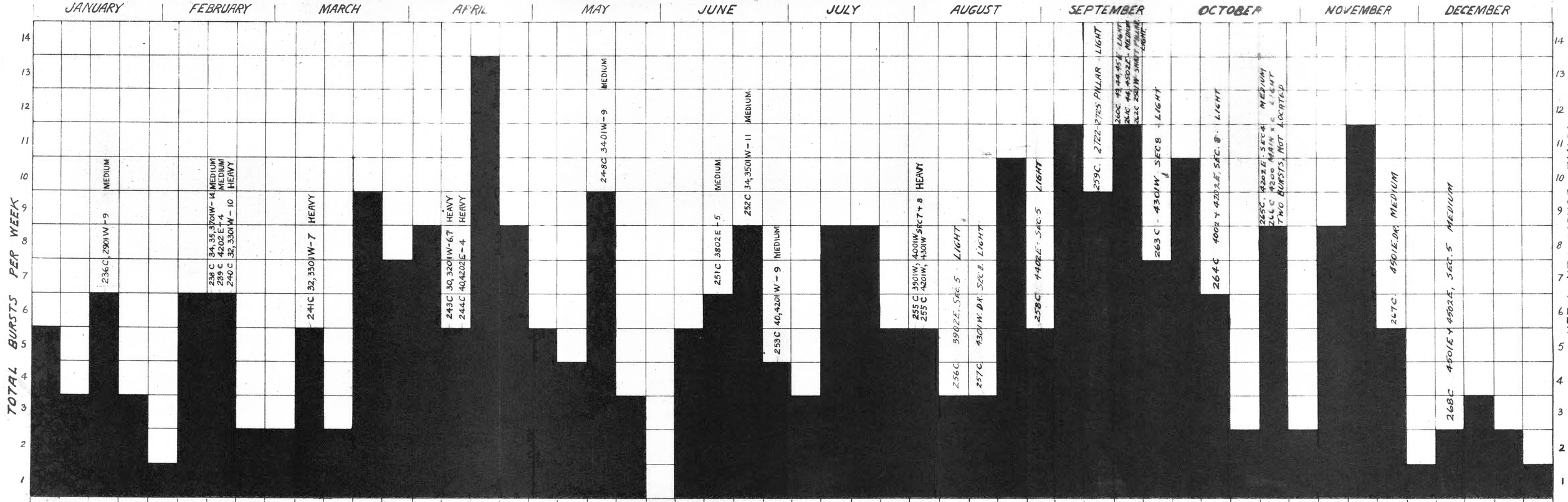
(b) To eliminate lost time due to the recording lamp being out, some signalling device should be installed.

(c) The sending of the seismograms to Ottawa has not been as regular as is desirable. Much better analysis of the records can be made if they were to reach Ottawa regularly, preferably once a week or, at least, twice a month.

(d) If the time corrections were determined and tabulated at Kirkland Lake, the adjoining (differing) rates would be better blended into one another and valuable information as to the causes of variation in the rates might be learned. Such information, if obtained, should always be endorsed on the back of the seismograms concerned.

Dominion Observatory,
Ottawa, Canada,
January 21, 1942.

ROCK BURST RECORD 1941 TOTAL BURSTS, BY WEEKS.



LAKE SHORE MINES LIMITED

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TABLE I

Lost Time Tabulation

TABLE I

In this tabulation the nearest number of minutes which were required to change the seismogram each day is entered first, in the appropriate intersection of column and line. Following, in the adjacent compartment for the same day and month, appears the number of minutes lost during that calendar day from various causes which are indicated by letters having reference to the sources of loss listed below. The total and percentage loss for each month are tabulated in the last two spaces, respectively, of the columns concerned.

a Power off.
b Lamp burned out.
c Adjustment of apparatus.
d Light inadvertently turned out.
e Light cord pulled from lantern.
f Clutch not engaged.
g Semaphore battery run down.
h Lightning surges burned out synchronous motor starting condenser.
i Chronometer contacts failed.
j Changing chronometers.
k Synchronous motor condenser failed temporarily.
m Broken connection in lamp circuit.
n Ceiling plug of lamp circuit dropped out.
p Set screw on main drive clutch worked loose.

TOTAL LOST TIME	PERCENTAGE LOST TIME
16168 min.	3.08 per cent
i.e $11^{d}05^{h}28^{m}$	

	Jan.		Feb.		Mar.		Apr.		May		June		July		Aug.		Sep.		Oct.		Nov.		Dec.		
1	1		1		1		3	9c	1		1		1		1			10c	1	975p	1		1		1
2	2		2		1		1		1		0		3		1		1			439p	3		2		2
3	1		1		1			55c	0			4f	2	14a	1		1		1		1	1a	1	1c	3
4	1		0		1		1		0			140if	1		1		1		3		2		2	2c	4
5	2		1		1		1		0			11c	1	3c	2		1		1		1		1		5
6	1		1		0		1		0		2		1		2		1	1c	2		1		1		6
7	1	4a	1	1a	0		0		0		2		2	796i	2		1		1		1		2		7
8		495b	1		1		2		1		3			429i	1		1		2		2		2		8
9		989b	2		1		1		0		3		1		1		1		2		1		1		9
10	1		1		1		1		1		3		1		1		1		1		1		1		10
11	1		1		0		1			344a	2		1	3j	1	5c	1		1		1		1		11
12	2	7c	1		0		1		0		4		1		1		2		1		1		1		12
13	1			720f	0		2			1148f	3		1		1		1			34ac	2	3c	1		13
14	1			753f	1		1	353g	0		3		1		1		2	493n	1	1a	1	3c	1		14
15	2		1		1		0	900g	0		4		2		1			435n	1		1		2		15
16	1		1		1		1		1		3		1		1		1	23a	1		2		1		16
17	1		1		1		1		1		2		1		1		1		1		2	1a	1		17
18	1	296d	0		1		1		0		2		1		1		1		1		1		1		18
19		1120d	1		0		2		1		2		2		2		1		1		2		2		19
20	1		1	604b	1	45c	1		2		1		2		2		1		1	5c	1	2a	1		20
21	1			719b	2		1		2		2	35h	1		1		1		1		1		2		21
22	1		1		1		1	1a	1		2		2		1		2		1		1		1		22
23	1		0		2	169c	1		1		3		2		1		1		1		1		1		23
24	1		1			58c	0		1		4		3		1		1		2	5c	1		2		24
25	1		1		4		1		1		2		1		1	230m	1		2	5c	1		1		25
26	0		0			139c	2		0		2		1			463m	1			706f	1		2		26
27	0		1			186c	1		1		2		0		1		2	2a	3	4c	2		2		27
28	0		1		8	25c	1		1		1		2	13a	1		1		1		1		1		28
29	1				1	3c	1		1		2		1	17k	1		1		1		1		0		29
30	2				1		1		1		2		1		1		1		1		1		1		30
31	1				2				2				0		1				1				2		31
T	2963		2820		660		1350		1513		1513		1315		733		996		2211		49		45		T
P	6.6		7.0		1.5		3.1		3.4		3.5		2.9		1.6		2.3		4.7		0.1		0.1		P

T A B L E II

Adjusted Chronometer Corrections

Adjusted Chronometer Readings

Jan.	1	+ 31.0	A	Mar.	3	- 0.1	A	May	3	+ 14.7	A
"	2	+ 31.9	A	"	4	0.	A	"	4	15.6	A
"	3	+ 1.2	A	"	5	0.	A	"	5	+ 16.5	A
"	4	2.3	A	"	6	0.	A	"	6	+ 17.5	A
"	5	3.5	A	"	7	+ 0.1	A	"	7	17.5	A
"	6	4.7	A	"	8	0.4	A	"	8	17.5	A
"	7	5.8	A	"	9	0.7	A	"	9	17.5	A
"	8	7.0	A	"	10	+ 1.0	A	"	10	17.5	A
"	9	8.2	A	"	11	+ 1.5	A	"	11	17.5	A
"	10	9.3	A	"	12	2.0	A	"	12	+ 17.5	A
"	11	10.5	A	"	13	2.5	A	"	13	+ 17.9	A
"	12	11.6	A	"	14	3.0	A	"	14	18.4	B
"	13	12.8	A	"	15	+ 3.5	A	"	15	19.0	B
"	14	13.9	A	"	16	+ 4.5	A	"	16	19.5	B
"	15	15.0	A	"	17	+ 4.5	A	"	17	20.0	B
"	16	+ 16.1	A	"	18	+ 3.8	A	"	18	20.6	B
"	17	+ 17.0	A	"	19	+ 3.0	A	"	19	21.1	B
"	18	17.9	A	"	20	+ 3.0	A	"	20	+ 21.6	B
"	19	18.8	A	"	21	3.0	A	"	21	+ 21.6	B
"	20	19.7	A	"	22	3.0	A	"	22	21.6	B
"	21	20.6	A	"	23	+ 3.0	A	"	23	+ 21.6	B
"	22	+ 21.5	A	"	24	+ 3.3	A	"	24	+ 21.7	B
"	23	?		"	25	3.5	A	"	25	21.8	B
"	24	+ 25.6	A	"	26	3.8	A	"	26	21.9	B
"	25	26.9	A	"	27	4.0	A	"	27	22.0	B
"	26	28.2	A	"	28	4.3	A	"	28	22.0	B
"	27	29.5	A	"	29	4.5	A	"	29	22.1	B
"	28	30.8	A	"	30	4.8	A	"	30	22.1	B
"	29	32.1	A	"	31	+ 5.0	A	"	31	22.1	B
"	30	33.5	A	Apr.	1	+ 5.0	A	June	1	+ 22.2	B
"	31	34.8	A	"	2	5.4	A	"	2	+ 22.6	A
Feb.	1	36.1	A	"	3	5.8	A	"	3	23.1	A
"	2	37.4	A	"	4	6.2	A	"	4	23.5	A
"	3	38.8	A	"	5	6.6	A	"	5	23.9	A
"	4	40.2	A	"	6	6.9	A	"	6	24.4	A
"	5	41.6	A	"	7	7.3	A	"	7	24.8	A
"	6	43.0	B	"	8	+ 7.7	A	"	8	25.3	A
"	7	44.4	B	"	9	+ 8.3	B	"	9	25.7	A
"	8	45.8	B	"	10	9.0	B	"	10	26.1	A
"	9	47.2	B	"	11	+ 9.0	B	"	11	26.6	A
"	10	48.6	B	"	12	+ 9.8	B	"	12	+ 27.0	A
"	11	50.0	B	"	13	10.0	B	"	13	+ 28.0	A
"	12	51.4	B	"	14	10.3	B	"	14	29.0	A
"	13	+ 52.8	B	"	15	+ 10.5	B	"	15	30.0	A
"	14	+ 54.2	C	"	16	+ 10.5	A	"	16	+ 31.0	A
"	15	55.8	C	"	17	+ 10.5	A	"	17	+ 32.1	A
"	16	57.3	C	"	18	+ 10.3	B	"	18	33.2	A
"	17	58.8	C	"	19	+ 10.0	A	"	19	33.3	A
"	18	+ 60.2	C	"	20	10.0	A	"	20	+ 34.4	A
"	19	- 0.5	A	"	21	10.0	A	"	21	+ 36.0	A
"	20	0.5	A	"	22	10.0	A	"	22	36.5	A
"	21	0.5	A	"	23	10.0	A	"	23	+ 37.0	A
"	22	0.5	A	"	24	10.0	A	"	24	+ 37.5	A
"	23	- 0.5	A	"	25	10.0	A	"	25	37.5	A
"	24	- 0.4	A	"	26	+ 10.0	A	"	26	37.5	A
"	25	0.3	A	"	27	+ 10.4	A	"	27	37.5	A
"	26	0.3	A	"	28	10.9	A	"	28	37.5	A
"	27	0.2	A	"	29	11.4	A	"	29	37.5	A
"	28	0.2	A	"	30	+ 11.9	A	"	30	+ 37.5	A
Mar.	1	0.1	A	May	1	+ 12.9	A	July	1	+ 38.0	A
"	2	0.1	A	"	2	13.9	A	"	2	39.0	A

Adjusted Chronometer Corrections

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July	3	+ 40.0	A	Sep.	2	+ 7.8	A	Nov.	2	- 8.9	B
"	4	+ 40.0	A	"	3	7.5	A	"	3	9.4	B
"	5	+ 40.0	A	"	4	7.2	A	"	4	- 10.0	B
"	6	+ 40.4	A	"	5	+ 6.9	A	"	5	- 10.8	A
"	7	40.8	A	"	6	+ 6.4	A	"	6	11.5	A
"	8	41.2	A	"	7	5.9	A	"	7	12.3	A
"	9	41.6	A	"	8	5.4	A	"	8	13.0	A
"	10	42.0	A	"	9	4.9	A	"	9	13.8	A
"	11	+ 42.4	A	"	10	4.4	A	"	10	- 14.5	A
"	12	+ ?		"	11	3.9	A	"	11	- 15.3	A
"	13	15.8	C	"	12	3.4	A	"	12	16.1	A
"	14	18.9	C	"	13	2.9	A	"	13	16.9	A
"	15	22.0	C	"	14	+ 2.5	A	"	14	17.8	A
"	16	25.1	C	"	15	+ 2.5	A	"	15	18.6	A
"	17	28.2	C	"	16	2.5	A	"	16	19.4	A
"	18	+ 31.3	C	"	17	+ 2.5	A	"	17	20.2	A
"	19	+ ?		"	18	+ 2.4	A	"	18	21.0	A
"	20	+ 15.0	A	"	19	2.3	A	"	19	21.8	A
"	21	15.0	A	"	20	2.2	A	"	20	22.6	A
"	22	15.0	A	"	21	+ 2.1	A	"	21	23.5	A
"	23	15.0	A	"	22	+ 2.0	A	"	22	24.3	A
"	24	15.0	A	"	23	2.0	A	"	23	25.1	A
"	25	15.0	A	"	24	2.0	A	"	24	25.9	A
"	26	15.0	A	"	25	2.0	A	"	25	26.7	A
"	27	15.0	A	"	26	2.0	A	"	26	27.5	A
"	28	15.0	A	"	27	+ 2.0	A	"	27	28.3	A
"	29	15.0	A	"	28	+ 2.1	A	"	28	29.2	A
"	30	15.0	A	"	29	2.2	A	"	29	- 30.0	A
"	31	15.0	A	"	30	2.2	A	"	30	- 31.0	A
Aug.	1	14.8	A	Oct.	1	2.3	A	Dec.	1	32.0	A
"	2	14.6	A	"	2	2.4	A	"	2	- 33.0	A
"	3	14.4	A	"	3	2.5	A	"	3	- 33.8	A
"	4	14.2	A	"	4	2.6	A	"	4	34.5	A
"	5	14.0	A	"	5	2.6	A	"	5	35.3	A
"	6	13.8	A	"	6	2.7	A	"	6	36.0	A
"	7	13.6	A	"	7	2.8	A	"	7	36.8	A
"	8	13.4	A	"	8	2.9	A	"	8	37.5	A
"	9	13.2	A	"	9	+ 3.0	A	"	9	38.3	A
"	10	13.0	A	"	10	+ 2.7	C	"	10	39.0	A
"	11	12.8	A	"	11	2.4	C	"	11	- 39.7	A
"	12	+ 12.6	A	"	12	+ 2.1	C	"	12	- 40.7	A
"	13	+ 11.0	A	"	13	+ 1.7	C	"	13	41.5	A
"	14	11.0	A	"	14	1.3	C	"	14	42.6	A
"	15	11.0	A	"	15	0.9	C	"	15	43.5	A
"	16	11.0	A	"	16	0.5	C	"	16	44.5	A
"	17	11.0	A	"	17	+ 0.1	C	"	17	45.5	A
"	18	+ 11.0	A	"	18	- 0.3	C	"	18	46.4	A
"	19	+ 10.8	A	"	19	- 0.5	A	"	19	47.4	A
"	20	10.6	A	"	20	1.1	A	"	20	48.3	A
"	21	10.4	A	"	21	1.7	A	"	21	49.3	A
"	22	10.2	A	"	22	2.3	A	"	22	50.3	A
"	23	10.0	A	"	23	2.9	A	"	23	51.2	A
"	24	9.8	A	"	24	3.5	A	"	24	52.2	A
"	25	+ 9.6	A	"	25	4.1	A	"	25	53.1	A
"	26	+ 9.0	A	"	26	4.7	A	"	26	54.1	A
"	27	9.0	A	"	27	5.3	A	"	27	55.1	A
"	28	9.0	A	"	28	- 6.0	A	"	28	- 56.0	A
"	29	+ 9.0	A	"	29	- 6.6	B	"	29	- 56.7	A
"	30	+ 8.7	A	"	30	7.1	B	"	30	57.4	A
"	31	8.4	A	"	31	7.7	B	"	31	58.0	A
Sep.	1	8.1	A	Nov.	1	8.3	B.				

T A B L E III

Detailed Tabulation of Seismograms

NOTE: Inadvertently, beginning with record No. 360 and continuing to the end of the year, the number scale indicating the value of the time record was inverted so that the indications are: 1 = excellent; 2 = fair; 3 = doubtful.

KIRKLAND LAKE SEISMOGRAM RECORD

Explanation of Symbols

oooooooo

(1) Dates are recorded as Day:Month

e.g. 19:12 indicates December 19.

(2) Times are recorded with hyphens separating hours, minutes and seconds, as: 2-33-41.5. In general, times quoted to minutes only are uncorrected chronometer values but when given to seconds are corrected.

(3) Value of the time signal is given by a number in the scale

See Note on front page of Table III.

0 to 3 with the following signification:

3 = excellent; 2 = fair; 1 = doubtful;

0 = lacking altogether or quite useless.

Brackets about the number denoting the value of the correction indicate that the source of the correction was a desk memorandum - not an automatically recorded signal. The number in this case indicates the degree of agreement of the particular correction with the line through the plotted points which was adopted as the clock rate graph.

(4) Time correction +/- means clock slow / fast.

(5) Amount of time correction is given in seconds and is followed by the hour (on the 24-hour system beginning at midnight) nearest to which the correction was obtained. If the correction was obtained on the first day of the record the hour is not underlined. If it was obtained on the second day of the record it is underlined. Thus: $+110^{s}$.:13 means that the clock was found to be 110 sec. slow at 1 p.m. on the second day of the record.

(6) In the remarks column the following letters indicate comments most likely to be used repeatedly:

B = Blasting at Lake Shore.

BT/BW = Blasting at Teck Hughes / Wright Hargreaves.

C = Charging equipment resonance interference.

F = Finger marks on record.

S = Stain from developer on record.

R+/R- = Rate of driving clock accelerated / retarded.

G = Some interference from gymnasium (badminton or dancing).

Is/Iw/Iv = Light intensity too strong / too weak / or variable.

a, b, c, etc. = Index letters to footnotes on same report sheet.

Brackets on any letter, e.g. (B), denote in general that the condition reported is relatively small. However, see also (3), above.

B/R/H, etc. at the end of the remarks line indicate the operator whose initials appear on the record as Butterfield / Robson / Hodgson, etc. After June 1 H indicates Hallick.

K I R K L A N D L A K E S E I S M O G R A M R E C O R D

January, 1941

No.	Rec'd	On Time	On Date	Off Time	Off Date	Time Correction Value	Time Correction Amount	Bursts	Quakes	Remarks	
197	13:1	12-40 p.m.	31:12	1-47 p.m.	1:1	-	-	3	0	a. Quiescent except for 3 bursts. One large.	G
198	"	1-48 p.m.	1:1	2-57 p.m.	2:1	3	0. :12	3	0	b. Quiescent except for 3 small bursts.	G
199	"	2-59 p.m.	2:1	2-58 p.m.	3:1	3	+ 1. :12	1	0	c. Line very good this period. One small burst only.	G
200	"	2-59 p.m.	3:1	2-56 p.m.	4:1	3	+ 2. : 8	1	0	(BT),d,(F).	G
201	"	2-57 p.m.	4:1	2-57 p.m.	5:1	-	-	2?	0	(B),(BT),(F).	G
202	"	2-59 p.m.	5:1	2-58 p.m.	6:1	3	+ 4.5 : 9	1+1?	0	(BT).	G
203	"	2-59 p.m.	6:1	2-36 p.m.	7:1	3	+ 6. :10	0	0	(B),(BT),e,(F). Line is very good.	G
204	"	2-37 p.m.	7:1	3-45 p.m.	8:1	1	+ 6.5 : 9	1	0	B,BT. Power cycles vary more than usual.	?
205	"	-	8:1	-	9:1	-	-	-	-	Bulb burned out after about a minute's run.	G
206	4:2	4-29 p.m.	9:1	6-07 p.m.	10:1	3	+ 9.0 :10	0	0	Iw,S. Top edge of sheet fogged. Cause?	G
207	"	6-08 p.m.	10:1	3-23 p.m.	11:1	-	-	0	0	Quiescent record. Good line.	G
208	"	3-24 p.m.	11:1	3-59 p.m.	12:1	2	+ 11.0 :16	1+1?	0	Is,B,(BT). Light turned too high.	G
209	"	4-01 p.m.	12:1	3-56 p.m.	13:1	3	+ 12.5 : 9	1?	0	f. Quiescent. Sunday sheet.	G
210	"	3-57 p.m.	13:1	5-51 p.m.	14:1	-	-	1?	0	B,g.	G
211	"	5-52 p.m.	14:1	6-00 p.m.	15:1	3	+ 15. : 9	0	0	(g). Quiescent. Slight fog.	G

a Bursts at 2-33-46; 4-36-59; and 8-46-24, all p.m. on Dec. 31. Second has duration of 2 seconds.

b Chronometer re-set at 12 o'clock (noon) on Jan. 2. c. Sheet slightly wrinkled in ferrotyping, Slightly fingerprinted.

d A series of offsets. LS. blasting (?) at 8-33. Lasted 1.5 minutes. No correlation. No LS. blasting at usual times.

e Power off for 4 minutes at 1-40 p.m. on 7th. f. Lamp intensity adjusted soon after sheet put on.

g Sensitivity seems low during this period or else blasting was less. (?).

K I R K L A N D L A K E S E I S M O G R A M R E C O R D

January, 1941

No.	Rec'd	On Time	On Date	Off Time	Off Date	Time Correction Value	Time Correction Amount	Bursts	Quakes	Remarks	
212	4:2	6-02 p.m.	15:1	5-51 p.m.	16:1	3	+ 16. : 9	0	0	(B),a. Slight fog.	G
213	"	5-52 p.m.	16:1	6-41 p.m.	17:1	3	+ 17. :10	2?	0	B,S,b,c. Badly stained. Intensity check made.	G
214	"	6-42 p.m.	17:1	6-47 p.m.	18:1	0	-	2	0	B,(F),S,d. Badly stained record.	G
215	"	6-48 p.m.	18:1	7-04 p.m.	18:1	-	-	-	-	Light inadvertently turned off after 16 min.	A+G
215	"	6-40 p.m.	19:1	5-46 p.m.	20:1	3	+ 19.5 :10	1?	0	(F),e. Good line this period.	A+G
216	"	5-47 p.m.	20:1	5-47 p.m.	21:1	3	+ 20.5 :10	3+1?	0	(BT). Three moderate bursts + one (?).	A
217	"	5-48 p.m.	21:1	6-20 p.m.	22:1	3	+ 21.5 : 9	2	0	(B),(BT),(F). No locations given for bursts listed.	G
218	"	6-21 p.m.	22:1	5-57 p.m.	23:1	-	-	2	0	B,f,g. Sheet ink spotted. Good LS. blasting record.	G
219	"	5-58 p.m.	23:1	6-22 p.m.	24:1	3	+ 24.5 :18	?	0	(BT). No LS. blasting recorded.	G
220	"	6-23 p.m.	24:1	8-21 p.m.	25:1	-	-	1	0	B. Well marked LS. blasting record.	G
221	"	8-22 p.m.	25:1	8-03 p.m.	26:1	3	+ 28.0 : 9	1	0	h. Sunday record.	G
222	24:2	8-03 p.m.	26:1	8-21 p.m.	27:1	2	+ 29.5 : 9	0	0	B. Three heavy blasts identified as such.	A+G
223	"	8-21 p.m.	27:1	11-15 p.m.	28:1	-	-	1	0	(B). Medium heavy burst 10-33-16 p.m. on 27th.	A+G
224	"	11-15 p.m.	28:1	4-42 p.m.	29:1	-	-	1?	0	(B). Line good this period.	A+G
225	"	4-43 p.m.	29:1	4-29 p.m.	30:1	1	+ 33. : 1	0	0	Quiescent record.	A+G
226	"	4-31 p.m.	30:1	5-11 p.m.	31:1	1	+ 34.5 :23	1	0	B,i,j. Small burst 3-05-10 p.m. on 31st.	A+G

a Sensitivity seems low - or else LS. blasting and TH. blasting is very much less than normal.

b Series of offsets resembling LS. blasting about 3-25 p.m. on 17th. No explanation. Regular LS. blasting missing in p.m.

c Clock rate diminishes slightly after this date.

d Two good sized burst offsets. Not included in typed list of bursts reported from mine.

e Time entered incorrectly one hour out throughout the whole sheet. Checked by LS. blasting and time on next sheet.

f One small and one moderate sized burst. g. Clock seems to have lost about 2 seconds too much in one day.

h Very large burst. Duration 2 sec. Location ? 1-43-30 a.m. on 26th.

i Lamp out 2-27 to 2-49 on 31. Cord pulled from socket on lamp housing. j. Blasting (?) at 3-23 p.m. on 31st.

K I R K L A N D L A K E S E I S M O G R A M R E C O R D

February, 1941

No.	Rec'd	On Time	On Date	Off Time	Off Date	Time Correction Value	Time Correction Amount	Bursts	Quakes	Remarks	
227	24:2	5-12 p.m.	31:1	5-07 p.m.	1:2	1	+ 36. :17	2	0	(F). Two small bursts recorded.	A+G
228	"	5-08 p.m.	1:2	3-28 p.m.	2:2	1	+ 37. :11	3?	0	B,(S). Three slight bursts(?) about 9 p.m. on 1st.	A+G
229	"	3-30 p.m.	2:2	5-50 p.m.	3:2	1	+ 38.5 : 9	?	0	(B). No trace of TH. blasting during this period.	A+G
230	"	5-51 p.m.	3:2	4-34 p.m.	4:2	1	+ 40. : 8	2?	0	(B),a. Line getting a little heavy.	A+G
231	"	4-34 p.m.	4:2	4-49 p.m.	5:2	1	+ 41.5 : 8	1?	0	B. One small offset in LS. blasting time.	A+G
232	"	4-50 p.m.	5:2	4-02 p.m.	6:2	1	+ 43.0 : 9	1	0	B,b. Definite small burst 6-02-14 p.m. on 5th.	A+G
233	"	4-03 p.m.	6:2	4-10 p.m.	7:2	-	-	1	0	B,(F),c. Power off one minute 11-04 a.m. on 7th.	A+G
234	"	4-11 p.m.	7:2	4-14 p.m.	8:2	0	-	1?	0	(B),F,d. No trace TH. blasting. Why?	A+G
235	"	4-15 p.m.	8:2	5-03 p.m.	9:2	-	-	1	0	(B),e. Small sharp burst at 3-17-57 a.m. on 9th.	A+G
236	"	5-05 p.m.	9:2	11-14 a.m.	10:2	1	+ 48.5 :10	0	0	Quiescent. Good line this period.	A+G
237	"	11-15 a.m.	10:2	10-05 a.m.	11:2	-	-	1	0	(B). Small burst 3-47-21 p.m. on 10th.	A+G
238	"	10-06 a.m.	11:2	11-58 a.m.	12:2	-	-	2	0	(S),f. Good record line.	A+G
239	"	11-59 a.m.	12:2	12 noon	13:2	1	+ 52. :18	3	0	(B),g. Good sample with burst on it.	A+G
240	"	-	13:2	-	14:2	-	-	-	-	Clutch not engaged. No record.	A+G
241	"	12-33 p.m.	14:2	1-15 p.m.	15:2	-	-	1	0	Small burst(?) in LS. blasting time on a.m. of 15th.	A+G

a Two small offsets. May be bursts or heavy blasts. b. Blasting resembling LS. as late as 3-24 a.m. on 5th.

c Small but definite burst at 8-05-57 p.m. on 6th. d. Fog due to leak in lamphouse top.

e Something resembling LS. blasting also at 3-44 to 3-46 a.m. on 9th. Not identified in correlation.

f Small burst at 2-58-18 and a medium one at 3-04-05 ; both p.m. on 11th.

g Moderate burst 3-40-50 p.m. on 12th; Small one at 4-23-21 p.m. on 12th; large one 10-24-16 a.m. on 13th. Duration 3 sec.

h Not enough time comparisons taken after February 6. Why does TH. blasting not record?

K I R K L A N D L A K E S E I S M O G R A M R E C O R D

February, 1941

No.	Rec'd	On Time	On Date	Off Time	Off Date	Time Correction Value	Time Correction Amount	Bursts	Quakes	Remarks	
242	24:2	1-16 p.m.	15:2	1-02 p.m.	16:2	-	-	0	0	(F),a. Sheet badly wrinkled in ferrotyping.	A+G
243	"	1-03 p.m.	16:2	2-02 p.m.	17:2	1	+ 58. :17	1	0	b. Quiescent except for one burst.	A+G
244	"	2-02 p.m.	17:2	12-37 p.m.	18:2	1	- 0.5 :16	?	0	B,(BT),c. LS. blasting again well marked.	A+G
245	"	12-37 p.m.	18:2	1-59 p.m.	19:2	1	- 0.5 :11	3	0	B,d. Sheet light struck on one corner.	A+G
246	19:3	2-00 p.m.	19:2	12-04 p.m.	20:2	1	- 0.5 :12	0	0	(B),(S). Good record line.	A+G
247	"	12-05 p.m.	20:2	1-56 p.m.	21:2	-	-	-	-	Lamp burned out 1-56 p.m. on 21st.	A+G
248	12:3	11-59 a.m.	21:2	12-31 p.m.	22:2	2	- 0.5 :12	0	0	(BT). Quiescent. Slight fog on record.	A+G
249	"	12-32 p.m.	22:2	12-02 p.m.	23:2	-	-	1?	0	(BT),(F). Drum motor oiled at 9-30 p.m.	A+G
250	"	12-02 p.m.	23:2	11-57 a.m.	24:2	2	- 0.5 :10	1	0	e. Moderately severe burst at 14-56-33 on 23rd.	A+G
251	"	11-58 a.m.	24:2	12-02 p.m.	25:2	3	- 0.5 :12	2	0	(F),f. Good records, plenty of sensitivity.	A+G
252	"	12-03 p.m.	25:2	11-58 a.m.	26:2	3	- 0.5 : 8	1	0	g. No trace of repeated LS. or TH. blasting.	A+G
253	"	11-58 a.m.	26:2	11-57 a.m.	27:2	3	- 0.5 : 8	0	0	B,h. Sheet stuck a little to ferrotype.	A+G
254	"	11-58 a.m.	27:2	11-57 a.m.	28:2	3	0. :10	1+?	0	(B),(BT),i. Sheet stuck on ferrotype.	A+G
255	"	11-58 a.m.	28:2	12-03 p.m.	1:3	3	0. :12	1?	0	Quiescent. Drum drive slightly irregular.	A+G

a Slight offsets resembling LS. blasting at 12-59 a.m. on 16th otherwise quiescent -- a Sunday sheet.
b Moderate burst. Duration 2 sec.(-) 5-11-30 on 17th. c. Chronometer reset and re-rated 16 hr. on 17th.
d Moderate burst 3-34-52. Large duration 3 sec. at 4-02-43. Small at 4-02-54. All p.m. on 18th.
e Good record lines this period and good drive by synchronous motor.
f Small offset at 13-15-11 and large one 13-48-59 , both on Feb. 24.
g Small offset at 13-47-02.
h Two slight irregularities in the time mark pattern. Synchronous motor speed changes.
i Time marks show slight irregularity in synchronous motor drive.

K I R K L A N D L A K E S E I S M O G R A M R E C O R D

March, 1941

No.	Rec'd	On Time	On Date	Off Time	Off Date	Time Correction Value	Time Correction Amount	Bursts	Quakes	Remarks	
256	12:3	12-04 p.m.	1:3	2-10 p.m.	2:3	3	0. : 9	1	0	B. Moderate burst 22-34-50 on 1st.	A+G
257	"	2-11 p.m.	2:3	12-03 p.m.	3:3	1	0. : 8	0	0	Quiescent sheet. Good line this period.	A+G
258	"	12-04 p.m.	3:3	12-10 p.m.	4:3	3	0. : 9	2	0	(BT),a. Line growing stronger but still OK.	A+G
259	"	12-11 p.m.	4:3	11-57 a.m.	5:3	1	0. : 9	1	0	Quiescent. Moderate burst 6-28-34.	A+G
260	"	11-58 a.m.	5:3	11-57 a.m.	6:3	1	0. : 8	0	0	(B),(BT),b.	A+G
261	"	11-57 a.m.	6:3	12-25 p.m.	7:3	-	-	0	0	(B),(BT). Good spot intensity.	A+G
262	"	12-25 p.m.	7:3	11-56 a.m.	8:3	3	+ 0.5 : 9	0	0	(B),c. Line growing rather weak.	A+G
263	"	11-57 a.m.	8:3	12-05 p.m.	9:3	1	+ 1.0 : 9	0	0	(B),(BT),d. Line much improved.	A+G
264	"	12-06 p.m.	9:3	12-07 p.m.	10:3	3	+ 1.0 : 9	1	0	e. Quiescent. Sheet not well fixed.	A+G
265	"	12-08 p.m.	10:3	12-03 p.m.	11:3	3	+ 1.5 : 9	1	0	(B),(BT),f. Slight spots of fog.	A+G
266	19:3	12-03 p.m.	11:3	12-09 p.m.	12:3	3	+ 2.0 : 10	0	0	B,(S). Slight cycle irregularity about 2 a.m.12th.	A+G
267	"	12-09 p.m.	12:3	11-57 a.m.	13:3	3	+ 2.5 : 8	0	0	B,(BT),(F). Quiescent record.	A+G
268	"	11-57 a.m.	13:3	12-03 p.m.	14:3	3	+ 3.0 : 12	0	0	(B). Sheet somewhat fogged.	A+G
269	"	12-04 p.m.	14:3	11-58 a.m.	15:3	1	+ 3.5 : 9	1+1?	0	B,g. Very good line intensity.	A+G
270	"	11-59 a.m.	15:3	11-57 a.m.	16:3	3	+ 4.5 : 9	1	0	h. Some fog on sheet. Finger prints (E.A.H.)	A+G+H

a Two small bursts 22-31-28 p.m. on 3rd and 2-53-14 a.m. on 4th. b. Spot intensity reduced 13-50 on 5th.

c Offset series resembling LS. blasting 2-51 to 2-52. d. Spot intensity increased 12-10 p.m. on 8th.

e Moderately heavy burst 10-50-34 a.m. on 10th. Duration about 2 sec.

f Moderately heavy burst 4-44-40 a.m. on 11th. Duration 2 sec.+

g Small burst (?) in blasting time at 14-47-25 on 14th.

h Chronometer handled a good deal (carefully) in measuring for wall box installation.

K I R K L A N D L A K E S E I S M O G R A M R E C O R D

March, 1941

No.	Rec'd	On Time	On Date	Off Time	Off Date	Time Correction Value	Time Correction Amount	Bursts	Quakes	Remarks	
271	19:3	11-58 a.m.	16:3	11-58 a.m.	17:3	2	+ 4.5 : 9	0	0	(F). Quiescent. Finger prints by E.A.H.	G+H
272	"	11-59 a.m.	17:3	11-49 a.m.	18:3	2	+ 4.5 :18	1?	0	(B),(BT),(F),a,b,c. Sheet buckled in ferrotyping.	G+H
273	"	11-50 a.m.	18:3	12-03 p.m.	19:3	1	+ 3.5 :18	1	0	B,BT,(F),d.Slight fog.Higher sensitivity apparent.	G
274	20:3	12-03 p.m.	19:3	1-26 p.m.	20:3	3	+ 3.0 :10	2?	0	B,BT,e. FIRST SHEET OF TIME MARKS DOWNWARD.	G
275	21:3	1-27 p.m.	20:3	12-06 p.m.	21:3	2	+ 3.0 : 9	2+?	0	B,BT,f. VERY MUCH INCREASED SENSITIVITY	G+H
276	29:3	12-08 p.m.	21:3	12-12 p.m.	22:3	1	+ 3.0 :14	1?	0	B,BT,(F),g. Sensitivity still seems very good.	G+H
277	"	12-13 p.m.	22:3	12-22 p.m.	23:3	1	+ 3.0 :10	0	0	B,(BT). Good record of LS. blasting.	G+H
278	"	12-24 p.m.	23:3	14-47 p.m.	23:3	-	-	0	0	h. Offsets are well recorded.	H
279	"	17-36 p.m.	23:3	12-13 p.m.	24:3	-	-	0	0	i. FIRST SHEET FULL CYLINDRICAL LENS	G
280	"	12-36 p.m.	24:3	2-05 p.m.	24:3	-	-	0	0	j. Short test sheet.	G+H
281	"	2-18 p.m.	24:3	6-51 p.m.	24:3	-	-	0	0	Short test sheet. Focus seems bad.	H

a Chronometer put on wall in new mounting. In place about 3-15 p.m. on 17th. b. LS. blasting(?) at 3-49 p.m. on 17th.

c Experimenting with mine seismograph on same pier with usual surface set-up. Interchange Heiland geophones at 10-31+ a.m. on 18th putting original Heiland geophone on mine seismograph and vice-versa.

d Semaphore installed noon on 19th as extra timer. Installed direct (no attenuator circuit) at noon on 20th.

e No record from 11-32 a.m. to 12-16 p.m. on 20th caused by rewiring without attenuator in circuit. Aerial down.

f First sheet without attenuator and with second (mine) geophone on this set-up. Semaphore timing.

g Seismometer bumped at 20-47 on 21st which shifted spot reducing recording intensity.

h Short test sheet. The offsets are all due to experimental thrusts. No bursts. Mine seismograph running.

i First sheet with full width of cylindrical lens. Time marks fade out about 19^h.

j Tests sheet to determine relative sensitivity of two geophones (no. 357--Second one purchased and No. 331-First one purchased). Details in log notes. They seem about equal in sensitivity to test.

KIRKLAND LAKE SEISMOGRAM RECORD

March, 1941

No.	Rec'd	On Time	On Date	Off Time	Off Date	Time Correction Value	Time Correction Amount	Bursts	Quakes	Remarks
282	29:3	7-02 p.m.	24:3	12-03 p.m.	25:3	2	+ 3.5 :12	2?	0	(B),BT. Focus seems poor. H
283	"	12-06 p.m.	25:3	5-37 p.m.	25:3	-	-	?	0	B,a. Focus seems poor. Spot too heavy. H
284	"	5-38 p.m.	25:3	11-21 a.m.	26:3	-	-	?	0	B,BT. Focus seems poor. Adjusted each change. H
285	"	11-22 a.m.	26:3	11-34 a.m.	26:3	-	-	0	0	Adjusted spot while sheet was running and reset.
285	"	11-56 a.m.	26:3	2-07 p.m.	26:3	-	-	0	0	Focus still poor. H
286	"	4-05 p.m.	26:3	4-23 p.m.	26:3	-	-	0	0	Adjusted spot several times while sheet was running.
286	"	4-30 p.m.	26:3	7-01 p.m.	26:3	-	-	0	0	Focus not satisfactory yet.
286	"	7-07 p.m.	26:3	12-10 p.m.	27:3	-	-	0	0	Some time lost by fog when adjusting. H
287	"	12-12 p.m.	27:3	3-28 p.m.	27:3	-	-	?	0	B. Focus not satisfactory yet. H
288	"	6-31 p.m.	27:3	9-09 a.m.	28:3	2	+ 4.0 :22	0	0	(B),(BT). Line improving but not satisfactory. H
289	31:3	9-10 a.m.	28:3	10-56 a.m.	28:3	-	-	0	0	B, a, Test sheet run through by Z.E.G. Slits were
289	"	11-21 a.m.	28:3	6-01 p.m.	28:3	-	-	0	0	removed and filament alone used as source. G+H
290	"	6-08 p.m.	28:3	11-16 a.m.	29:3	2	+ 4.5 :11	1?	0	B,(S). Fog much less, but focus not good yet. H
291	"	11-17 a.m.	29:3	12-27 p.m.	30:3	-	-	?	0	B,BT,(F). Further test increasing voltage. Log kept. G+H
292	"	12-28 p.m.	30:3	11-05 p.m.	31:3	-	+ 5.0 :12	1?	0	b. Quiescent. Some fog over whole sheet (voltage high) G+H
293	1:4	11-07 a.m.	31:3	10-02 a.m.	1:4	2	+ 5.0 : 9	1?	0	Line too faint. Adjusted to higher value after. H

a The filament alone is here used as source. Front and back slits were removed and only the two baffles farthest from the lamp remain in place. The image is markedly sharper but there is a great deal too much stray light fogging the sheet. On changing to record No. 290 Z.E.G. blocked off around the cylindrical lens with tape.

b The stray light problem must be solved. Sheet developed full 2 min. shows good record of E.A.H. touching geophone. Amplitude .7 in. Problem promises to be solved soon.

KIRKLAND LAKE SEISMOGRAM RECORD

April, 1941

No.	Rec'd	On Time	On Date	Off Time	Off Date	Time Correction Value	Time Correction Amount	Bursts	Quakes	Remarks	
294	3:4	11-56 a.m.	1:4	2-03 p.m.	1:4	-	-	0	0	Short test sheet. Line too heavy.	H
295	"	2-05 p.m.	1:4	3-10 p.m.	1:4	-	-	0	0	(F). Short test. Line still too heavy.	H
296	"	3-18 p.m.	1:4	1-43 p.m.	2:4	-	-	0	0	BT. Line too heavy. Time marks unsymmetrical.	H
297	"	1-44 p.m.	2:4	9-55 a.m.	3:4	2 +	5.5 :20	I?	0	B,(F),a. Excellent record.Night LS. blasting sharp.	H
298	"	10-14 a.m.	3:4	1-38 p.m.	3:4	-	-	0	0	b. Time marks better. Good clean line.	G+H
299	4:4	2-13 p.m.	3:4	3-45 p.m.	3:4	-	-	0	0	(F).No trace of LS. blasting. Very good line.	H
300	5:4	3-46 p.m.	3:4	8-27 a.m.	4:4	2 +	6.0 :18	0	0	(B),(BT). Beautifully clear line. No fog.	H
301	6:4	8-28 a.m.	4:4	9-32 a.m.	5:4	2 +	6.5 : 2	1	0	B,BT,c,d. Good clean record.	H
302	7:4	9-33 a.m.	5:4	11-27 a.m.	6:4	0	-	0	0	(B),BT. Some LS. blasting (?) 3 a.m. on 6th.	H+G
303	"	11-28 a.m.	6:4	11-32 a.m.	7:4	3 +	7.0 : 8	0	0	Quiescent. Sat.-Sun. sheet. Good record.	H+G
304	8:4	11-32 a.m.	7:4	8-04 a.m.	8:4	2 +	7.5 : 8	0	0	B,BT,e.	H
305	9:4	8-06 a.m.	8:4	9-14 a.m.	9:4	0	-	?	0	B,BT. Time signal by key seems in error.	H
306	"	9-15 a.m.	9:4	10-19 a.m.	9:4	-	-	0	0	Sheet put on to check developer strength.	H
307	10:4	10-20 a.m.	9:4	9-26 a.m.	10:4	2 +	8.5 : 9	1	0	B,BT,f. Time signal NG. Correction by eye-ear.	H

a After removing this sheet the galvanometer was tilted slightly more to make time mark symmetrical.
b Reduced the light intensity a little. c Slightly increasing light intensity each day to get optimum.
d Moderate burst 22-12-09 on 4th. Felt by V.E.H. and Z.E.G. in laboratory. Not located in LS. workings.
e Gear marks show for first time in slight fog at edge of heavy line.
f Fairly heavy burst. Duration 14 sec. Felt in laboratory. Time 23-09-14 on 9th. In 3001W. Wrecked the hydraulic gauge.

K I R K L A N D L A K E S E I S M O G R A M R E C O R D

April, 1941

No.	Rec'd	On Time	On Date	Off Time	Off Date	Time Correction Value	Time Correction Amount	Bursts	Quakes	Remarks	
308	18:4	9-27 a.m.	10:4	9-50 a.m.	11:4	2	+ 9.0 :11	?	0	B,BT. Blasting record unusually well marked.	G+A
309	"	9-51 a.m.	11:4	12-41 p.m.	12:4	1	+ 9.5 : 9	1+?	0	B,(S),Is,a.	A
310	"	12-42 p.m.	12:4	2-21 p.m.	13:4	-	-	1+?	0	B,Is,b.	A
311	"	2-23 p.m.	13:4	12-42 p.m.	14:4	-	-	0	0	Is,c. Blasting (?) at 11-07 a.m. on 14th.	A
312	"	12-43 p.m.	14:4	3-41 p.m.	15:4	1	+ 10.5 :15	0	0	B,BT,Is,d.	A
313	"	3-41 p.m.	15:4	2-03 p.m.	16:4	1	+ 10.5 : 9	1	0	B,BT,e. Line intensity adjusted. Good line.	G
314	28:4	2-04 p.m.	16:4	3-53 p.m.	17:4	1	+ 10.5 :14	1+4?	0	B,BT. Heavy LS. blasting 2-34 a.m. on 16th.	G
315	"	3-54 p.m.	17:4	6-08 p.m.	18:4	-	-	1+4?	0	B,BT,S. Developer too old.	G
316	"	6-09 p.m.	18:4	3-09 p.m.	19:4	2	+ 10.0 : 9	1+2?	0	B,S,(F),f.	G
317	"	3-11 p.m.	19:4	5-06 p.m.	20:4	-	-	?	0	B,BT,S,g.	G
318	"	5-07 p.m.	20:4	6-39 p.m.	21:4	2	+ 10.0 : 9	1	0	B,h. New developer beginning with this record.	G
319	"	6-40 p.m.	21:4	5-49 p.m.	22:4	1	+ 10.0 :17	1?	0	(S),i.	G

a Severe burst; full scale. Duration 30 sec. Began at 5-46-50 a.m. on 12th.

b Short sharp burst offset at 8-12-43 a.m. on 13th. c Chronometer failed.

d No time signals from 6-07 p.m. on 14th to 3 p.m. on 15th. Semaphore battery had run down.

e Slight burst at 1-06-48 a.m. on 16th. f Three recorded offsets resembling bursts. Not noted in mine.

g Primary power off 9-02 to 11-27 a.m. on 20th. Mine seismograph (LSM No. 5) was run on surface during this time at 3" per min. thus avoiding any "lost time". h Burst (?) at 5-15 p.m. on 20th. Not noted in mine.

i Power off for about 1 min. at 11-19 a.m. on 22nd.

K I R K L A N D L A K E S E I S M O G R A M R E C O R D

April, 1941

No.	Rec'd	On Time	On Date	Off Time	Off Date	Time Correction Value	Time Correction Amount	Bursts	Quakes	Remarks	
320	28:4	5-50 p.m.	22:4	5-53 p.m.	23:4	1	+ 10.0 : 8	1+?	0	B,BT,S,a. Stain due to long washing (?)	G
321	"	5-54 p.m.	23:4	5-38 p.m.	24:4	1	+ 10.0 : 8	1?	0	B,S,b. Sheet torn slightly in removing from ferrotype.	A
322	"	5-38 p.m.	24:4	5-12 p.m.	25:4	1	+ 10.0 :15	1?	0	B,BT,(S),b. " " " " " " "	A
323	"	5-13 p.m.	25:4	3-58 p.m.	26:4	1	+ 10.0 :15	1?	0	B,BT,b,c.	A
324	"	4-00 p.m.	26:4	3-08 p.m.	27:4	-	-	1?	0	S,F,b,c,d.	A
325	7:5	3-09 p.m.	27:4	3-13 p.m.	28:4	3	+ 11.0 :14	0	0	F,c,e. Fresh developer beginning with this record.	G
326	"	3-14 p.m.	28:4	2-04 p.m.	29:4	3	+ 11.5 :14	2+?	0	B,BT,F,(S),c,e,f.	A
327	"	2-05 p.m.	29:4	1-07 p.m.	30:4	3	+ 12.0 : 8	2?	0	B,BT,(F),(S).	A
328	"	1-08 p.m.	30:4	11-57 a.m.	1:5	-	-	2?	0	BT,S,(F).	A

a Sharp burst (?) about 9-21 p.m. on 23rd. Not reported in mine. Duration very short.

b Similar offsets at about same time (± 30 min.) on sheets 321-324.

c Marked changes in light intensity for short intervals during the record. Sudden beginnings.

d Burst 246C at 10-30 a.m. on 27th in 5001W shows no record (60 tons muck). Type "light".

e Effects similar to a and b above at beginning of Teck Hughes blasting about 10-30 p.m. on 28th and 29th.

f Burst 247C at 1-50 a.m. on 29th in 3401W shows no record (20 tons muck). Type "light".

K I R K L A N D L A K E S E I S M O G R A M R E C O R D

May, 1941

No.	Rec'd	On Time	On Date	Off Time	Off Date	Time Correction Value	Time Correction Amount	Bursts	Quakes	Remarks	
329	7:5	11-58 a.m.	1:5	11-59 a.m.	2:5	2	+ 14.0 : 9	0	0	B,BT,Iw,a. Light intensity seems low.	A
330	"	12 noon	2:5	3-37 p.m.	3:5	-	-	3	0	B,(S),b.	A
331	2:6	3-37 p.m.	3:5	4-56 p.m.	4:5	-	-	0	0	B,(S),F.	A
332	"	4-56 p.m.	4:5	7-35 p.m.	5:5	3	+ 16.0 :17	0	0	Line too weak for proper registration.	G
333	"	7-35 p.m.	5:5	3-56 p.m.	6:5	-	-	1?	0	(S). Line restored to proper intensity.	G
334	"	3-56 p.m.	6:5	3-19 p.m.	7:5	3	+ 17.5 :15	2?	0	B,BT. Sensitivity low or blasting weak.	G
335	"	3-19 p.m.	7:5	5-07 p.m.	8:5	3	+ 17.5 :15	0	0	B,F,c. Voltage variation (?) marked.	G
336	19:5	5-08 p.m.	8:5	5-30 p.m.	9:5	2	+ 17.5 :18	0	0	B,BT,S,F.	G
337	"	5-30 p.m.	9:5	7-06 p.m.	10:5	-	-	2	0	B,BT,(F). Good line intensity.	G
338	"	7-07 p.m.	10:5	1-55 a.m.	12:5	-	-	0	0	B,BT,d.	G
339	"	1-55 a.m.	12:5	12-15 a.m.	13:5	2	+ 17.5 : 8	0	0	B,BT.	G
340	"	-	13:5	-	13:5	-	-	-	-	Clutch not engaged. No record.	G
341	"	7-23 p.m.	13:5	6-43 p.m.	14:5	3	+ 18.5 :10	2	0	B,BT,e.	A

a No known bursts in Lake Shore corresponding to three small records, two about 11-30 a.m. on 3rd and one 2-33 p.m. the same day.

b No trace of 305S "between day and night shifts" on the 3rd.

c For ± about a week the length of a minute on the record varies greatly from minute to minute, seemingly due to erratic paper stretching. HAVE ADOPTED HERE THE MEAN OF THE TWO MINUTES ABOVE THE SIGNAL AND/OR THE TWO BELOW AS THE MINUTE LENGTH IN COMPUTING THE CHRONOMETER CORRECTION.

d Primary power off from 9-06 to 14-50 on 11th. Bursts at 2-56-44 a.m. on 11th and 9-40-40 p.m. on 11th. Not listed in Lake Shore burst records.

e Bursts at 2-47-44 and at 6-33-39 (both a.m.) on 14th. Neither listed in Lake Shore burst records. Duration each about 4 sec.

K I R K L A N D L A K E S E I S M O G R A M R E C O R D

May, 1941

No.	Rec'd	On Time	On Date	Off Time	Off Date	Time Correction Value	Time Correction Amount	Bursts	Quakes	Remarks	
342	19:5	6-43 p.m.	14:5	6-43 p.m.	15:5	2	+ 19.0 : 9	1+1?	0	B,BT,a.	A
343	19:5	6-43 p.m.	15:5	6-06 p.m.	16:5	3	+ 19.5 : 9	2	0	B,(S),(F),b.	A
344	28:5	6-07 p.m.	16:5	6-13 p.m.	17:5	3	+ 19.5 : 9	1?	0	B,BT,(S),(F),Iw. Sheet stuck to ferrotype.	A
345	"	6-14 p.m.	17:5	7-45 p.m.	18:5	3	+ 21.0 : 9	1+?	0	BT,F,Iw,c. Slight ferrotype trouble.	A
346	"	7-45 p.m.	18:5	7-06 p.m.	19:5	2	+ 21.0 : 9	0	0	B,F,Iw. Slight ferrotype trouble.	A
347	"	7-07 p.m.	19:5	4-10 p.m.	20:5	1	+ 21.5 :16	1	0	B,BT,d. Line intensity restored to normal.	A
348	"	4-12 p.m.	20:5	2-05 p.m.	21:5	2	+ 22.0 :14	1	0	B,BT,(F),e,f.	A
349	"	2-07 p.m.	21:5	2-05 p.m.	22:5	2	+ 22.0 :12	0	0	B. Line good, blast recording small. Time by key.	A
350	"	2-06 p.m.	22:5	2-08 p.m.	23:5	3	+ 21.5 : 9	0	0	B,BT. Normal blast recording. Time by key.	A
351	"	2-09 p.m.	23:5	3-05 p.m.	24:5	3	+ 22.0 : 8	3	0	B,BT,g.	G
352	"	3-06 p.m.	24:5	4-50 p.m.	25:5	2	+ 22.5 :15	0	0	B,BT. Line fluctuation marked about his time.	G
353	"	4-51 p.m.	25:5	5-32 p.m.	26:5	3	+ 22. : 9	0	0	No offsets. Record line seems good.	A
354	12:7	5-32 p.m.	26:5	4-04 p.m.	27:5	3	+ 22.5 : 8	0	0	B. Line fluctuations quite marked.	G
355	"	4-05 p.m.	27:5	4-50 p.m.	28:5	-	-	1	0	B,BT. Sheet wrinkled in drying.	A
356	"	4-51 p.m.	28:5	5-23 p.m.	29:5	2	+ 22.5 :10	1?	0	BT. Peculiar line fluctuations, short, intense.	A
357	"	5-24 p.m.	29:5	6-26 p.m.	30:5	2	+ 22.0 : 9	0	0	B,BT,(F). Same fluctuations as on sheet next above.	A
358	"	6-27 p.m.	30:5	7-03 p.m.	31:5	2	+ 22.0 :15	0	0	B,BT. Very good line.	A
359	"	7-05 p.m.	31:5	8-52 p.m.	1:6	3	+ 22.5 :19	0	0	BT.	A

a Burst 304S at 2-50 p.m. on 15th (50 tons muck) 3307W8. b Two bursts at 9-16-36 a.m. and 12-15-49 p.m. on 16th. Duration 4 sec. each. Not listed by LS. No. 305S "between 3 a.m. and 7 a.m. on 16th" not registered.

c Burst at 11-34-26 p.m. on 17th. Not listed in LS. burst record. d Burst 248C (220 tons muck) in 3401, 3406, 3409, 3414W at 2-51-52 a.m. on 20th. Fell exactly on crease of sheet. e Burst 249C (150 tons muck) in 4001W7 at 8-45-54 p.m. on 20th. f Chronometer contact short on 59th minute every four hours 1^h, 5^h, 9^h, etc.

g Burst 307S (20 tons muck) in 4202E at 9-33-20 p.m. on 23rd. Two other bursts on same sheet not listed in LS. record.

KIRKLAND LAKE SEISMOGRAM RECORD

June, 1941

No.	Rec'd	On Time	On Date	Off Time	Off Date	Time Correction Value	Time Correction Amount	Bursts	Quakes	Remarks	
360	12:7	8-53 p.m.	1:6	12-20 a.m.	3:6	1	+ 22.0 :22	0	0	B,(F),a,b. Good line, no fluctuations.	A
361	"	12-22 a.m.	3:6	11-56 p.m.	3:6	-	-	0	0	B,BT. Slight ferrotype trouble.	A
362	"	-	-	-	-	-	-	-	-	Clutch not engaged.	G
363	"	11-17 p.m.	4:6	1-41 p.m.	5:6	-	-	1?	0	B,c. Slight ferrotype trouble.	G
364	"	1-52 p.m.	5:6	3-46 p.m.	6:6	3	+ 24.0 : 9	1+3?	0	B,BT,d. Several small bursts(?) not on LS. reports.	H
365	"	3-48 p.m.	6:6	2-06 p.m.	7:6	3	+ 24.5 :10	1?	0	BT,F,S.	H
366	"	2-08 p.m.	7:6	2-25 p.m.	8:6	2	+ 25.0 : 9	0	0	B,BT. Strong light fluctuations.	H
367	"	2-28 p.m.	8:6	3-04 p.m.	9:6	1	+ 25.5 : 9	1?	0	BT. Slight change in drum speed about 22^h on 8th.	H
368	"	3-07 p.m.	9:6	2-11 p.m.	10:6	1	+ 26.0 : 9	2+3?	0	B,BT,c. Two fairly large bursts.None on LS. reports.	H
369	"	2-14 p.m.	10:6	2-09 p.m.	11:6	2	+ 26.5 : 9	1?	0	B,BT. Very sudden marked light fluctuations.	H
370	"	2-11 p.m.	11:6	2-10 p.m.	12:6	2	+ 27.0 :14	1	0	B,BT,S,f.	H
371	"	2-14 p.m.	12:6	3-10 p.m.	13:6	1	+ 28.0 :15	1+4?	0	B,BT,(F),b,g.	H
372	"	3-13 p.m.	13:6	2-10 p.m.	14:6	1	+ 29.0 :14	1?	0	B,BT,F.	H
373	"	2-13 p.m.	14:6	2-07 p.m.	15:6	2	+ 30.0 : 9	1	0	B,BT. Burst at 2-42 a.m. on 15th. Possibly (310S).	H

a Chronometer now misses entirely the 59th minute every four hours 1^h, 5^h, 9^h, etc. b Sheet spotted by pre-stamping.

c No trace of 308S or 309S (8 tons and 2 tons) 3307W8 and 4001W7 at 1-45 a.m. and 10-25 a.m. on 5th. Small burst at 2-33 a.m. on 5th. d Frank Hallick began work in Lab. e Burst at 9-10-32 p.m. on 9th. Duration 4 sec. One at 9-12-39 p.m. Duration 1+ sec. f Small burst at 1-14-28 a.m. on 12th. Not on LS. reports. No.250C (10 tons muck) not recorded on seismograph. g Burst 251C (170 tons muck) 3802E at 2-42-36 a.m. on 13th. Duration 10 sec. ca.

K I R K L A N D L A K E S E I S M O G R A M R E C O R D

June, 1941

No.	Rec'd	On Time	On Date	Off Time	Off Date	Time Correction Value	Time Correction Amount	Bursts	Quakes	Remarks	
374	12:7	2-11 p.m.	15:6	2-07 p.m.	16:6	2	+ 31.0 : 8	1	0	F. Burst at 8-49-10 p.m. on 15th. Probably 310S.	H
375	"	2-10 p.m.	16:6	2-06 p.m.	17:6	2	+ 32.0 : 8	2?	0	B,BT,(F). Light fluctuation negligible.	H
376	"	2-08 p.m.	17:6	2-06 p.m.	18:6	3	+ 33.0 : 8	0	0	B,BT,(F). Some short strong fluctuations.	H
377	"	2-08 p.m.	18:6	3-09 p.m.	19:6	2	+ 34.0 : 8	1?	0	B,BT,Is. Some strong blasting(?) at 11-00 p.m. on 18th.	H
378	"	3-11 p.m.	19:6	7-18 a.m.	20:6	-	-	3	0	B,BT,a. Line very strong. Blasting well recorded.	H
379	"	7-19 a.m.	20:6	7-17 a.m.	21:6	2	+ 35.5 :17	2	0	B,BT. Light fluctuations sharply defined on strong line.	H
380	"	7-19 a.m.	21:6	9-32 a.m.	22:6	-	-	0	0	B,b. First sheet stamped Kirkland Lake.	G
381	"	9-34 a.m.	22:6	7-19 a.m.	23:6	1	+ 36.5 :10	1	0	Is,c,d. No trace of blasting. Light fluctuations severe.	G
382	"	7-22 a.m.	23:6	7-11 a.m.	24:6	1	+ 37.0 :16	0	0	B,BT,d. Sheet fogged at one end.	H
383	"	7-15 a.m.	24:6	7-10 a.m.	25:6	1	+ 37.5 :16	2	0	B,BT,e. Two short bursts; neither listed.	H
384	"	7-12 a.m.	25:6	7-14 a.m.	26:6	1	+ 37.5 :16	0	0	B,BT,d,e.	H
385	"	7-16 a.m.	26:6	7-14 a.m.	27:6	1	+ 37.5 :16	1	0	B,BT,d,e. Sharp short burst not listed in LS. report.	H
386	"	7-16 a.m.	27:6	7-14 a.m.	28:6	1	+ 37.5 :16	1+1?	0	B,BT,(S),d,e. Burst 311S recorded 2-41 a.m. on 28th.	H
387	"	7-15 a.m.	28:6	7-21 a.m.	29:6	1	+ 37.5 :16	1+1?	0	Burst 253C (75 tons) at 2-39 a.m. on 29th.	H
388	"	7-23 a.m.	29:6	7-09 a.m.	30:6	-	-	0	0	B,d. Several sharp short lengths of heavy line.	H
389	"	7-11 a.m.	30:6	7-26 a.m.	1:7	1	+ 37.5 :16	0	0	Iw,d. Sheet rather dirty - dirt on ferrotype.	H

a Three bursts - one only being listed: 252C (40 tons), 3301, 3401, 3501W, 1-29-26 a.m. on 20th. Duration 8 sec. ca. Another fairly strong but not listed at 2-55-41 a.m. on 20th, and another still smaller at 2-22-05 a.m. on 20th.

b Starting condenser on synchronous motor burned out by lightning surge. Substituted value was incorrect resulting in slow drive for rest of the chart. Total time "lost" only 35 min. d Spotty chart due to pre-stamping.

e Very sharp isolated heavy line lasting about half an hour. Sharp beginning and ending. No other on sheet.

K I R K L A N D L A K E S E I S M O G R A M R E C O R D

July, 1941

No.	Rec'd	On Time	On Date	Off Time	Off Date	Time Correction Value	Time Correction Amount	Bursts	Quakes	Remarks	
390	12:7	7-27 a.m.	1:7	7-07 a.m.	2:7	2	+ 38.5 :21	3?	0	Is,a.	H
391	"	7-10 a.m.	2:7	7-13 a.m.	3:7	1	+ 39.5 :16	0	0	B,BT,a. Some light fluctuations. Strong line.	H
392	"	7-14 a.m.	3:7	7-09 a.m.	4:7	1	+ 40.0 :16	3?	0	B,BT,a. Power off 12-33 to 12-47 p.m. on 3rd.	H
393	"	7-10 a.m.	4:7	7-12 a.m.	5:7	1	+ 40.0 :16	1	0	B,BT,Is,a,b.	H
394	"	7-13 a.m.	5:7	9-47 a.m.	6:7	1	+ 40.0 :16	1	0	B,BT,(F),a.Line intensity adjusted 5-04 p.m. on 5th.	H
395	"	9-48 a.m.	6:7	7-11 a.m.	7:7	3	+ 40.5 :21	1	0	a.No blasting recorded.Small burst 5-16 p.m. on 6th.	H
396	"	7-13 a.m.	7:7	7-09 a.m.	8:7	-	-	0	0	B,BT,a,c.	H
397	"	7-10 a.m.	8:7	7-08 a.m.	9:7	1	+ 41.0 :16	0	0	B,BT,(S),a.Ferrotype trouble.Sharp light fluctuations.	H
398	"	7-09 a.m.	9:7	7-09 a.m.	10:7	2	+ 41.5 :16	4+?	0	B,BT,(S),a.Several sharp small bursts not on LS.reports.	H
399	"	7-10 a.m.	10:7	7-08 a.m.	11:7	0	-	2?	0	B,BT,a,d.Slight burst about 3 p.m. on 10th.	H
400	16:7	7-09 a.m.	11:7	7-11 a.m.	12:7	3	+ 13.5 :16	0	0	B,BT,a,e.	H
401	"	7-12 a.m.	12:7	7-06 a.m.	13:7	1	+ 15.5 : 8	1+3?	0	B,BT,a,f.	H
402	"	7-07 a.m.	13:7	7-07 a.m.	14:7	1	+ 18.0 : 8	1?	0	Good clean sheet. No light fluctuations.	H
403	17:7	7-08 a.m.	14:7	7-14 a.m.	15:7	1	+ 21.5 : 8	2?	0	No blasting recorded. Good line.	H
404	"	7-16 a.m.	15:7	7-09 a.m.	16:7	1	+ 23.5 : 8	1?	0	B,BT. Sheet slightly wrinkled in drying.	H

a Sheet spotted by pre-stamping. b Light burst (?) in LS. blasting time on 5th a.m. Not listed in LS. reports.

c Chronometer contacts closed at 10-44 a.m. on 7th opening only for about 2 min. at the hour for remainder of chart.

d Probably 312S (50 tons) 4001W7.

e Sent chronometer to Ottawa for cleaning and adjustment. Substituted No. 1144 at 1-43 p.m. on 11th.

f Sharp bump at 3-50 p.m. on 12th in 1250' level of Wright-Hargreaves. Duration on record 3 sec.+.

KIRKLAND LAKE SEISMOGRAM RECORD

July, 1941

No.	Rec'd	On Time	On Date	Off Time	Off Date	Time Correction Value	Time Correction Amount	Bursts	Quakes	Remarks	
405	21:7	7-10 a.m.	16:7	7-05 a.m.	17:7	1	+ 27.5 :16	2?	0	B,BT. No trace of 313S at 2-30 a.m. on 17th.	H
406	"	7-06 a.m.	17:7	7-15 a.m.	18:7	-	-	1	0	B,BT,a.	H
407	1:8	7-16 a.m.	18:7	7-09 a.m.	19:7	1	+ 34.5 :16	1?	0	B. Slight burst (?) in LS. blasting on 19th.	H
408	"	7-11 a.m.	19:7	8-21 a.m.	20:7	1	+ 15.0 :17	0	0	(B).Dent chronometer re-installed at 4-41 p.m. on 20th.	H
409	"	8-23 a.m.	20:7	7-09 a.m.	21:7	-	-	1?	0	(F). Radio reception very poor.	H
410	"	7-10 a.m.	21:7	7-04 a.m.	22:7	1	+ 15.0 :16	1?	0	B,BT,b,c.	H
411	"	7-06 a.m.	22:7	7-09 a.m.	23:7	1	+ 15.0 :16	1?	0	B,BT,d,e. Blasting very well recorded.	H
412	"	7-11 a.m.	23:7	7-11 a.m.	24:7	1	+ 15.0 :16	1	0	B,d. Small burst (?) 2-41 p.m. on 23rd.	H
413	"	7-12 a.m.	24:7	1-31 p.m.	24:7	1	+ 15.0 : 8	1?	0	Sheet removed for burst felt in No. 6 shaft,3900'-level.	H
414	"	1-33 p.m.	24:7	7-04 a.m.	25:7	-	-	0	0	B,BT. Motor drive shows slight irregularity.	H
415	"	7-05 a.m.	25:7	7-05 a.m.	26:7	1	+ 15.0 :16	1+1?	0	B,BT,f. No. 317S well marked at 3-16 p.m. on 25th.	H
416	"	7-06 a.m.	26:7	7-50 a.m.	27:7	1	+ 15.0 :15	1?	0	B,(BT),Is,(F).	H
417	"	7-50 a.m.	27:7	7-04 a.m.	28:7	1	+ 15.0 :16	1	0	Is,g.	H
418	"	7-06 a.m.	28:7	7-06 a.m.	29:7	1	+ 15.0 :16	1+3?	0	B,BT,Is,h,i,j.	H
419	"	7-07 a.m.	29:7	7-09 a.m.	30:7	1	+ 15.0 :16	1?	0	Is,k.	H
420	"	7-10 a.m.	30:7	7-10 a.m.	31:7	1	+ 15.0 :16	3	0	SEVERE BURSTS TRAP THREE MEN ON 4200'-LEVEL.	H
421	"	7-10 a.m.	31:7	7-10 a.m.	1:8	1	+ 15.0 :16	0	0	Line becoming too strong. No blasting recorded.	H

a Short sharp burst at 1-41 a.m. on 18th. Not listed by LS. b Chronometer contacts failed 11-52 a.m. to 3-36 p.m. on 21st.

c Small burst (?) 2-24 p.m. on 21st. May be 314S reported at 3 p.m. on 21st. Quite small. d Some minor chronometer contact failures. e No trace of 315S at 9 p.m. on 22nd. f Line becoming stronger day by day.

g Sharp burst of short duration at 5-30.5 a.m. on 28th. Not listed by LS. h Power failures 9-44 to 9-57 a.m. on 28th. i Synchronous motor out of order for 17 min. about 4 p.m. on 28th. j Sharp burst 12-31.5 a.m. on 29th. Not listed by LS. k No. 318S July 29 3-8 a.m. not recorded.

K I R K L A N D L A K E S E I S M O G R A M R E C O R D

August, 1941

No.	Rec'd	On Time	On Date	Off Time	Off Date	Time Correction Value	Time Correction Amount	Bursts	Quakes	Remarks	
422	6:9	7-11 a.m.	1:8	7-05 a.m.	2:8	1	+ 14.5 :16	1	0	(B),(BT).	H
423	"	7-06 a.m.	2:8	8-33 a.m.	3:8	1	+ 14.5 :16	0	0	(B),(BT). Light spot a little heavy.	G+H
424	"	8-34 a.m.	3:8	7-07 a.m.	4:8	-	-	0	0	(B). Spot adjusted to optimum strength.	G+H
425	"	7-08 a.m.	4:8	7-22 a.m.	5:8	1	+ 14.0 :16	1?	0	B,a. System seems lacking in sensitivity.	G+H
426	"	7-24 a.m.	5:8	7-39 a.m.	6:8	1	+ 13.5 :16	0	0	B,b.	G+H
427	"	7-41 a.m.	6:8	7-10 a.m.	7:8	2	+ 13.5 :16	0	0	B,c.	G+H
428	"	7-12 a.m.	7:8	7-15 a.m.	8:8	1	+ 13.5 :16	0	0	B,d. System seems quite sensitive again.	G+H
429	"	7-16 a.m.	8:8	7-16 a.m.	9:8	1	+ 13.0 :16	1	0	B,e. Bump not listed by Lake Shore.	H
430	"	7-17 a.m.	9:8	7-24 a.m.	10:8	1	+ 13.0 :16	0	0	(B).	H
431	"	7-25 a.m.	10:8	7-07 a.m.	11:8	2	+ 13.0 : 8	1+1?	0	Burst 256C at 3.13 p.m. on 12th.	H
432	"	7-08 a.m.	11:8	7-47 a.m.	12:8	1	+ 13.0 :16	0	0	B. Power off 20:18 to 20:24 August 11.	H
433	"	7-48 a.m.	12:8	7-28 a.m.	13:8	2	+ 12.5 :16	2?	0	B. Pressure gauge record 14:55 August 12 (?).	H
434	"	7-29 a.m.	13:8	7-07 a.m.	14:8	1	+ 11.0 :16	0	0	(B),(BT).	H
435	"	7-08 a.m.	14:8	7-04 a.m.	15:8	1	+ 11.0 :16	0	0	B,(BT).	H
436	"	7-05 a.m.	15:8	7-04 a.m.	16:8	1	+ 11.0 :16	2?	0	Tests OK but no blasting recorded.	H
437	"	7-05 a.m.	16:8	7-16 a.m.	17:8	1	+ 11.0 :16	1?	0	B,(BT),f.	H

a Calibration check put on geophone for first time. Outer end of test throw does not develop out very well.
b For a test this sheet developed four minutes with old developer.
c Calibration test modified but still not very satisfactory. d Diagram of wiring for tester on back sheet 428.
e Sheet developed four minutes. Full excursion of spot now records.
f Series reported on this list were all good records, well developed and fixed.

KIRKLAND LAKE SEISMOGRAM RECORD

August, 1941

No.	Rec'd	On Time	On Date	Off Time	Off Date	Time Correction Value	Time Correction Amount	Bursts	Quakes	Remarks	
438	6:9	7-17 a.m.	17:8	7-04 a.m.	18:8	1	+ 11.0 : 8	2?	0	(B),a. Excellent test deflections.	H
439	"	7-05 a.m.	18:8	7-05 a.m.	19:8	1	+ 11.0 :16	0	0	B,BT.	H
440	"	7-07 a.m.	19:8	7-12 a.m.	20:8	1	+ 10.5 :16	3	0	B.	H
441	"	7-14 a.m.	20:8	7-04 a.m.	21:8	1	+ 10.5 :16	1	0	B,BT. Heavy burst 19-01-50 on 20th, Teck Hughes.	H
442	"	7-05 a.m.	21:8	7-12 a.m.	22:8	1	+ 10.0 :16	1?	0	(B),(F),b.	H
443	"	7-13 a.m.	22:8	7-07 a.m.	23:8	1	+ 9.5 :16	2+?	0	B,c. No record of bursts at Lake Shore.	H
444	"	7-08 a.m.	23:8	8-47 a.m.	24:8	1	+ 9.5 :16	1?	0	B.	H
445	"	8-48 a.m.	24:8	7-09 a.m.	25:8	?	?	1	0	d,e. No trace of blasting. Tests OK.	H
446	"	7-10 a.m.	25:8	8-10 p.m.	25:8	1	+ 9.5 :16	0	0	B,f. Two sections with heavy lines.	H
447	"	7-43 a.m.	26:8	7-08 a.m.	27:8	1	+ 9.0 : 8	0	0	B,(BT). No trace of burst 320S.	H
448	"	7-09 a.m.	27:8	7-08 a.m.	28:8	1	+ 9.0 : 8	0	0	(B),(BT).	H
449	"	7-09 a.m.	28:8	7-10 a.m.	29:8	1	+ 9.0 :16	1	0	B,BT,g.	H
450	"	7-11 a.m.	29:8	7-13 a.m.	30:8	1	+ 9.0 :16	2	0	B,BT,h.	H
451	"	7-14 a.m.	30:8	7-25 a.m.	31:8	1	+ 8.5 :16	0	0	B,(F). Spot is becoming a little heavy.	G+H
452	12:9	7-26 a.m.	31:8	7-13 a.m.	1:9	1	+ 8.0 : 9	0	0	(B),(F),i. Spot a little too heavy.	H

a New developer. Time 3 minutes.
b Some offset from ink of form stamped on reverse.
c Slight irregularity in drive about 21:30 on 22nd.
d Heavy burst 21:31:45. Location not known. Not listed by Lake Shore.
e One line heavier than the others around 17:30 on 24th.
f Light line broken at 20:10 on 25th. No record beyond.
g Heavy burst at 2:05:30 on 29th. Not listed by Lake Shore. Location not known.
h Burst 258C registered at 6:13:50 p.m. on 29th. Small. Also small one at 2:31:20 p.m. on 29th. Not listed.
i Paper clutch required repair. Ten minutes lost in changing record beginning of No. 452.

K I R K L A N D L A K E S E I S M O G R A M R E C O R D

September, 1941

No.	Rec'd	On Time	On Date	Off Time	Off Date	Time Correction Value		Time Correction Amount	Bursts	Quakes	Remarks	
453	12:9	7-23 a.m.	1:9	7-13 a.m.	2:9	2	+	7.5 :16	0	0	(B),(BT),a.	H
454	"	7-14 a.m.	2:9	7-08 a.m.	3:9	1	+	7.5 :16	0	0	(B),BT,a. Tests OK.	H
455	"	7-09 a.m.	3:9	7-08 a.m.	4:9	1	+	7.5 :16	1+2?	0	b. No trace of blasting.	H
456	"	7-09 a.m.	4:9	7-35 a.m.	5:9	1	+	7.0 :16	0	0	B,(BT),c.	H
457	"	7-36 a.m.	5:9	7-10 a.m.	6:9	1	+	7.0 :16	0	0	B,BT.	H
458	"	7-11 a.m.	6:9	8-53 a.m.	7:9	1	+	6.5 :16	1?	0	B,d.	H
459	27:9	8-54 a.m.	7:9	7-04 a.m.	8:9	1	+	6.0 :16	1	0	e. No trace of blasting. Tests OK.	H
460	"	7-05 a.m.	8:9	7-05 a.m.	9:9	1	+	5.5 :16	1	0	BT,f.	H
461	"	7-06 a.m.	9:9	7-09 a.m.	10:9	1	+	5.0 :16	1	0	(B),(BT),g.	H
462	"	7-10 a.m.	10:9	7-13 a.m.	11:9	1	+	4.5 :16	1?	0	B.	H
463	"	7-14 a.m.	11:9	7-10 a.m.	12:9	1	+	4.0 :16	1	0	B,h. Light spot very good.	H
464	"	7-12 a.m.	12:9	7-06 a.m.	13:9	1	+	3.5 :16	1?	0	BT. Some fog caused by adjusting camera.	H
465	"	7-07 a.m.	13:9	7-16 a.m.	14:9	1	+	3.0 :16	0	0	B,BT.	H
466	"	7-18 a.m.	14:9	3-47 p.m.	14:9	1	+	2.5 :16	0	0	i.	H
467	"	7-15 a.m.	15:9	7-04 a.m.	16:9	1	+	2.5 :16	1?	0	B,BT.	H

a Spot adjusted to lighter value but intensity varies giving sheet a mottled appearance.

b No. 321S registered at 2:55:30. Small. c Drive shows an acceleration about 1 a.m. on 5th.

d One minute lost due to blown fuse in light supply. e Bursts 2:52 p.m. on 7th. Not listed by Lake Shore.

f Burst at 12:27:30 p.m. on 8th. Not listed by Lake Shore. g Burst 322S registered 2:33 a.m. Small.

h Burst 259C registered at 1:19:20 p.m. on 11th. Small.

i Power plug dropped out 3:48 p.m. on 14th (Sunday). No further record.

K I R K L A N D L A K E S E I S M O G R A M R E C O R D

September, 1941

No.	Rec'd	On Time	On Date	Off Time	Off Date	Time Correction Value	Time Correction Amount	Bursts	Quakes	Remarks	
468	27:9	7-05 a.m.	16:9	7-05 a.m.	17:9	1	+ 2.5 :16	2?	0	B,BT,a.	H
469	"	7-06 a.m.	17:9	7-07 a.m.	18:9	1	+ 2.5 :16	1	0	B,BT. Heavy burst 323S at 3:18 a.m. on 18th.	H
470	"	7-08 a.m.	18:9	7-04 a.m.	19:9	-	-	1	0	(B),BT,b, Severe magnetic storm. Aurorae.	H
471	"	7-05 a.m.	19:9	7-10 a.m.	20:9	2	+ 2.0 : 8	1+2?	0	c. Time signals very poor. Heavy static.	H
472	13:12	7-11 a.m.	20:9	7-41 a.m.	21:9	2	+ 2.0 :12	3?	0	(B).	H
473	"	7-42 a.m.	21:9	7-08 a.m.	22:9	-	-	1	0	Burst 261C at 1:50:30 p.m. on 21st.	H
474	"	7-10 a.m.	22:9	7-17 a.m.	23:9	2	+ 2.0 :16	0	0	B,BT. Line too heavy.	H
475	"	7-18 a.m.	23:9	7-07 a.m.	24:9	2	+ 2.0 :16	1	0	BT,d. Adjustment of light intensity to optimum.	H
476	"	7-08 a.m.	24:9	7-06 a.m.	25:9	1	+ 2.0 :16	1?	0	B,BT.	H
477	"	7-07 a.m.	25:9	7-11 a.m.	26:9	2	+ 2.0 : 8	2?	0	B,BT. Offsets seem out of focus.	H
478	"	7-12 a.m.	26:9	7-07 a.m.	27:9	1	+ 2.0 :16	0	0	B,BT. Power failure 2 min.	H
479	"	7-09 a.m.	27:9	8-55 a.m.	28:9	1	+ 2.0 :16	1	0	(B),(BT),(F),e.	H
480	"	8-56 a.m.	28:9	7-13 a.m.	29:9	1	+ 2.0 : 9	0	0	(B),(BT),(F).	H
481	"	7-14 a.m.	29:9	7-08 a.m.	30:9	1	+ 2.0 :16	4?	0	(B),BT.	H
482	"	7-09 a.m.	30:9	7-12 a.m.	1:10	1	+ 2.0 :16	2?	0	Sheet yellow, "Faulty developer".	H

a Power off 21:15 to 21:39 on 16th. Visit by mining inspectors p.m. on 16th.
b Burst just before midnight on 18th. Not listed by Lake Shore. Wide amplitude relatively short duration.
c Burst 260C at 2:31:20 a.m. on 20th. Heavy record. d Burst 262C at 9:36:30 p.m. on 23rd.
e Burst 263C at 2:58:30 p.m. on 27th.

KIRKLAND LAKE SEISMOGRAM RECORD

October, 1941

No.	Rec'd	On Time	On Date	Off Time	Off Date	Time Correction Value	Time Correction Amount	Bursts	Quakes	Remarks	
483	13:12	7-13 a.m.	1:10	7-45 a.m.	1:10	-	-	-	-	Set screw loose. Drum did not drive but 32 min.	H
484	"	7-19 a.m.	2:10	7-08 a.m.	3:10	2 +	2.5 :16	6?	0	(B),(BT),(F),a.	H
485	"	7-09 a.m.	3:10	7-07 a.m.	4:10	1 +	2.5 :16	0	0	(F),b. Tests OK but no tremors recorded.	H
486	"	7-10 a.m.	4:10	8-02 a.m.	5:10	1 +	2.5 :16	3	0	BT,c.	H
487	17:12	8-03 a.m.	5:10	7-31 a.m.	6:10	1 +	2.5 : 9	1?	0	(F),b. Slightly overdeveloped.	H
488	"	7-33 a.m.	6:10	7-07 a.m.	7:10	1 +	3.0 :16	2?	0	b. Slightly overdeveloped.	H
489	"	7-08 a.m.	7:10	7-03 a.m.	8:10	1 +	3.0 :16	0	0	(F). Light spot faint.	H
490	"	7-05 a.m.	8:10	7-11 a.m.	9:10	2 +	3.0 :16	1	0	B. Burst 324S at 9:23:40 a.m. on 8th.	H
491	"	7-13 a.m.	9:10	7-05 a.m.	10:10	2 +	3.0 :16	2?	0	(BT),d.Overdeveloped.Very dirty sheet "Old Stock".	H
492	"	7-06 a.m.	10:10	7-04 a.m.	11:10	-	-	3+1?	0	F,e. Overdeveloped.	H
493	"	7-05 a.m.	11:10	8-46 a.m.	12:10	-	-	0	0	F,f.Automatic tests wrong time,switch wrong position.	G+H
494	"	9-02 a.m.	12:10	7-56 a.m.	13:10	2 +	2.0 :16	0	0	Line too heavy. Automatic tests on wrong time.	G+H
495	"	7-57 a.m.	13:10	7-04 a.m.	14:10	2 +	2.0 : 8	1?	0	Tests on wrong time.Power failure 1 min. Line OK.	H
496	"	7-05 a.m.	14:10	7-06 a.m.	15:10	2 +	1.5 :16	2?	0	BT. Chronometer points stuck several times.	H
497	"	7-07 a.m.	15:10	7-10 a.m.	16:10	2 +	.0 :16	1?	0	Nice clean sheet. Chronometer trouble continues.	H

a Instrument checked at time of changing records, all set screws being tightened. b Offset from form stamp.

c Two bursts (?) at 10:08 p.m. on 4th and another at 3:48:30 a.m. on 5th. None listed as located by Lake Shore.

d No trace of 325S "at 3:05 a.m. on 9th". e Three bursts between 3:09 and 3:14 a.m. on 11th. One listed as 264C "at 3:10 a.m. on 11th".

f Power failure of 20 min. at 3:55 a.m. on 12th

K I R K L A N D L A K E S E I S M O G R A M R E C O R D

October, 1941

No.	Rec'd	On Time	On Date	Off Time	Off Date	Time Correction Value	Time Correction Amount	Bursts	Quakes	Remarks	
498	17:12	7-11 a.m.	16:10	7-11 a.m.	17:10	1	+ .5 :16	0	0	Chronometer trouble continues.	H
499	"	7-12 a.m.	17:10	7-04 a.m.	18:10	-	-	0	0	B,BT. Chronometer trouble very much worse.	H
500	"	7-05 a.m.	18:10	8-27 a.m.	19:10	-	-	1?	0	Light spot faint. Chronometer trouble continues.	H
501	18:12	8-28 a.m.	19:10	7-08 a.m.	20:10	1	- .5 : 9	0	0	Chronometer trouble continues.	H
502	"	7-09 a.m.	20:10	7-07 a.m.	21:10	1	- 1.0 :16	1?	0	(BT),a.	H
503	"	7-08 a.m.	21:10	7-06 a.m.	22:10	1	- 2.0 :16	0	0	(BT),b. Sheet slightly broken in washing.	H
504	"	7-07 a.m.	22:10	7-13 a.m.	23:10	1	- 2.5 :16	2?	0	Two medium bursts (?) not listed by Lake Shore.	H
505	"	7-14 a.m.	23:10	7-06 a.m.	24:10	1	- 3.0 :16	1+1?	0	(BT),(BT),(a),c,d. Still a little chronometer trouble.	H
506	"	7-08 a.m.	24:10	7-08 a.m.	25:10	1	- 3.5 :18	0	0	(B),(BT),d. Spot adjusted to a too strong value.	H
507	"	7-10 a.m.	25:10	8-54 a.m.	26:10	1	- 4.0 : 8	0	0	(F). No trace of 328S "at 7:15 a.m. on 25th".	H
508	"	8-40 p.m.	26:10	7-09 a.m.	27:10	-	-	0	0	Clutch not engaged till 8:40 p.m. on 26th.	H
509	"	7-12 a.m.	27:10	7-16 a.m.	28:10	1	- 5.5 : 8	1?	0	B,BT. Spot adjusted to optimum value.	H
510	"	7-17 a.m.	28:10	7-06 a.m.	29:10	1	- 6.0 :16	2	0	(B),BT,e. Well marked bursts on good line.	H
511	"	7-07 a.m.	29:10	7-05 a.m.	30:10	1	- 7.0 :16	1?	0	(B),(BT). Good records. Tests OK.	H
512	"	7-06 a.m.	30:10	7-08 a.m.	31:10	1	- 8.0 :16	0	0	(B),(BT).	H
513	"	7-09 a.m.	31:10	7-06 a.m.	1:11	1	- 8.0 :16	1?	0	BT. Good clean record, optimum line.	H

a Offsets from forms stamped on back. b No trace of 326S "at 10:50 p.m. on 21st".

c Well marked burst at 3:01:30 a.m. on 24th, listed as 265C. Also one at 4:27:30 listed as 266C.

d No trace of 327S "at 7:00 a.m. on 24th. e Well marked burst at 10:25:30 p.m. and another at 11:14:30 p.m. on 28th. One listing only in Lake Shore record "between 10:26 and 11:15; not located".

K I R K L A N D L A K E S E I S M O G R A M R E C O R D

November, 1941

No.	Rec'd	On Time	On Date	Off Time	Off Date	Time Correction Value	Time Correction Amount	Bursts	Quakes	Remarks	
514	18:12	7-07 a.m.	1:11	9-41 a.m.	2:11	-	-	2?	0	B,BT. Two heavy offsets about LS blasting time.	G+H
515	"	9-44 a.m.	2:11	7-18 a.m.	3:11	1	- 9.0 :11	0	0	(B),(BT). Power failure for 1 minute.	G+H
516	"	7-19 a.m.	3:11	7-04 a.m.	4:11	1	- 9.5 : 8	?	0	(B),(BT). Some rather heavy LS blasting.	H
517	"	7-06 a.m.	4:11	7-09 a.m.	5:11	1	- 10.0 : 8	0	0	B,(BT). Good clean records.	H
518	"	7-10 a.m.	5:11	7-11 a.m.	6:11	1	- 11.0 : 8	1?	0	Tests OK. No record of disturbance.	H
519	"	7-12 a.m.	6:11	7-14 a.m.	7:11	1	- 12.0 :17	1+1?	0	Burst (?) at 8:16 a.m. on 6th. Not listed.	H
520	"	7-15 a.m.	7:11	7-08 a.m.	8:11	1	- 12.5 : 8	0	0	B,BT.	H
521	"	7-10 a.m.	8:11	9-25 a.m.	9:11	1	- 13.5 :17	1?	0	B,BT,a. One heavy blast (?) 3 a.m. on 9th.	H
522	"	9-26 a.m.	9:11	7-07 a.m.	10:11	-	-	0	0	(BT). Automatic tests at wrong time.	H
523	"	7-08 a.m.	10:11	7-03 a.m.	11:11	1	- 14.5 :17	1?	0	B. Some heavy blasts (?) at LS time.	H
524	"	7-04 a.m.	11:11	8-48 a.m.	12:11	1	- 15.5 :17	0	0	(B),(BT).	G+H
525	"	8-49 a.m.	12:11	7-16 a.m.	13:11	1	- 16.5 :17	0	0	(BT),F.	H
526	"	7-18 a.m.	13:11	7-04 a.m.	14:11	1	- 17.5 : 8	0	0	(B). Spot adjusted to rather heavy value.	H
527	"	7-05 a.m.	14:11	7-34 a.m.	15:11	1	- 18.0 : 8	1	0	Spot adjusted down to optimum value.	H
528	"	7-35 a.m.	15:11	5-08 a.m.	16:11	-	-	2	0	B,c. Good clean record.	H

a Short power failure at 7:35 a.m. on 8th. b Burst (?) at 4:27:30 p.m. on 14th. May be 329S, which is listed as having occurred "between day and night shifts".

c Well marked burst at 10:04:15 p.m. on 15th and another at 3:04 a.m. on 16th. Neither listed.

K I R K L A N D L A K E S E I S M O G R A M R E C O R D

November, 1941

No.	Rec'd	On Time	On Date	Off Time	Off Date	Time Correction Value	Time Correction Amount	Bursts	Quakes	Remarks	
529	18:12	5-10 a.m.	16:11	7-09 a.m.	17:11	-	-	1+1?	0	(B),a,b. Sheet torn and repaired.	H
530	"	7-11 a.m.	17:11	7-19 a.m.	18:11	2	- 21.0 :10	0	0	(B). Good clean record. Tests OK.	H
531	"	7-20 a.m.	18:11	7-23 a.m.	19:11	1	- 22.0 : 9	1+2?	0	c. MINERS ON STRIKE.	H
532	"	7-25 a.m.	19:11	7-09 a.m.	20:11	1	- 23.0 :16	1+1?	0	d.	H
533	"	7-10 a.m.	20:11	8-07 a.m.	21:11	-	-	0	0	Power failures for about 2 minutes.	H
534	"	8-08 a.m.	21:11	7-24 a.m.	22:11	1	- 24.5 : 9	0	0	Clean record. Tests OK. No tremors registered.	H
535	"	7-25 a.m.	22:11	9-30 a.m.	23:11	1	- 25.0 : 9	0	0	(F). Some developer stain.	G+H
536	"	9-31 a.m.	23:11	8-09 a.m.	24:11	-	-	0	0	(F).	G+H
537	"	8-10 a.m.	24:11	8-10 a.m.	25:11	1	- 26.5 : 9	1?	0	Good clean record. Tests OK. No offsets.	H
538	"	8-11 a.m.	25:11	8-07 a.m.	26:11	1	- 27.0 : 9	0	0	Stain - "New developer; too warm".	H
539	"	8-08 a.m.	26:11	8-03 a.m.	27:11	-	-	0	0	Tests OK. Line good. Clean record. No offsets.	H
540	"	8-05 a.m.	27:11	8-56 a.m.	28:11	1	- 29.0 : 8	0	0	(F). No offsets. Tests OK.	H
541	"	8-57 a.m.	28:11	8-20 a.m.	29:11	-	-	0	0	(F). No offsets. Tests OK.	H
542	"	8-21 a.m.	29:11	8-39 a.m.	30:11	1	- 30.0 :11	0	0	Slight power variation about 8 p.m. on 29th.	H
543	"	8-40 a.m.	30:11	7-50 a.m.	1:12	-	-	0	0	Slight power variation about 1 p.m. on 30th.	H

a Well marked burst at 10:35:30 a.m. on 16th. Is probably 330S which is listed at 10:30 a.m. on 17th. There is no record of a burst at 10:30 a.m. on the 17th. b Power failure for about 1 minute.

c Well marked burst at 10:46:30 p.m. on 18th followed by smaller one about 10 sec. later and another small one 29 min. later at 11:15:30 p.m. on 18th. d Well marked burst 10:30:30 a.m. on 19th followed by smaller one 15 sec. later. Listed as 267C.

K I R K L A N D L A K E S E I S M O G R A M R E C O R D

December, 1941

No.	Rec'd	On Time	On Date	Off Time	Off Date	Time Correction Value	Time Correction Amount	Bursts	Quakes	Remarks	
544	18:12	7-51 a.m.	1:12	8-53 a.m.	2:12	3	- 33.0 : 8	1	0	(F),a. F.J.H. back to work in lab.	H
545	"	8-55 a.m.	2:12	8-09 a.m.	3:12	-	-	0	0	(F). Spot rather weak.	H
546	"	8-10 a.m.	3:12	8-18 a.m.	4:12	1	- 34.0 : 9	0	0	BT. Spot adjusted to heavier value.	H
547	"	8-20 a.m.	4:12	8-32 a.m.	5:12	-	-	0	0	(BT). Spot again adjusted to optimum value.	H
548	"	8-33 a.m.	5:12	8-10 a.m.	6-12	1	- 35.5 : 9	0	0	Good record. Tests OK. No offsets.	H
549	"	8-11 a.m.	6:12	9-40 a.m.	7:12	1	- 36.5 : 9	1	0	(BT),(F),b.	H
550	"	9-42 a.m.	7:12	8-12 a.m.	8:12	1	- 37.0 :10	0	0	(BT),(S).	H
551	19:12	8-14 a.m.	8:12	8-24 a.m.	9:12	1	- 37.5 : 9	0	0	Record OK. No offsets	H
552	"	8-25 a.m.	9:12	8-33 a.m.	10:12	1	- 38.5 : 9	0	0		H
553	"	8-34 a.m.	10:12	8-51 a.m.	11:12	1	- 39.0 : 9	0	0		H
554	"	8-52 a.m.	11:12	8-28 a.m.	12:12	1	- 40.0 :16	0	0	Tests seem to show slight falling off in sensitivity.	H
555	"	8-29 a.m.	12:12	8-09 a.m.	13:12	-	-	0	0	Tests definitely show less sensitivity.	H
556	"	8-10 a.m.	13:12	8-25 a.m.	14:12	2	- 42.0 : 9	0	0	No tests on this sheet. No offsets recorded.	H
557	"	8-26 a.m.	14:12	8-14 a.m.	15:12	3	- 42.5 :14	1?	0	(B),F. Tests show normal sensitivity on this sheet.	G+H
558	"	8-16 a.m.	15:12	8-34 a.m.	16:12	1	- 43.0 : 9	1?	0	(B),(F).	H

a Sharp burst at 4:02:45 p.m. on December 1. Not listed by Lake Shore.

b Well marked burst, listed as 268C, registered at 8:40 a.m. on 7th.

K I R K L A N D L A K E S E I S M O G R A M R E C O R D

December, 1941

No.	Rec'd	On Time	On Date	Off Time	Off Date	Time Correction Value	Time Correction Amount	Bursts	Quakes	Remarks	
559	8:1	8-35 a.m.	16:12	8-17 a.m.	17:12	1	- 44.0 :17	0	0	Record quiescent. Line and tests OK.	H
560	"	8-18 a.m.	17:12	8-25 a.m.	18:12	1	- 45.0 : 9	0	0	Sheet yellow. New developer -- too warm.	H
561	"	8-26 a.m.	18:12	8-23 a.m.	19:12	1	- 46.0 : 9	0	0	(F). Quiescent record. Tests OK.	H
562	"	8-25 a.m.	19:12	8-09 a.m.	20:12	1	- 47.0 : 9	1	0	Burst 10:01 a.m. on 19th. Not listed.	H
563	"	8-10 a.m.	20:12	8-12 a.m.	21:12	1	- 48.0 : 9	0	0	Good record. No trace of blasting.	H
564	"	8-14 a.m.	21:12	8-12 a.m.	22:12	1	- 49.0 : 9	0	0	(F). Record good but no blasting recorded.	H
565	"	8-13 a.m.	22:12	8-15 a.m.	23:12	1	- 50.0 :17	1	0	Small burst 4:19:30 p.m. on 22. Not listed.	H
566	"	8-16 a.m.	23:12	8-18 a.m.	24:12	1	- 51.0 : 9	0	0	No trace of blasting. Tests OK.	H
567	"	8-20 a.m.	24:12	8-32 a.m.	25:12	2	- 52.0 :10	1	0	Small burst 9:09:30 a.m. on 24th. Not listed.	H
568	"	8-33 a.m.	25:12	9-43 a.m.	26:12	1	- 53.0 :10	0	0	No trace of blasting. Record good. Tests OK.	H
569	"	9-45 a.m.	26:12	8-13 a.m.	27:12	1	- 54.0 :10	0	0	Tests OK. No blasting shown.	H
570	"	8-15 a.m.	27:12	8-47 a.m.	28:12	1	- 55.0 : 9	0	0	Sheet slightly torn. Record good. Tests OK.	H
571	"	8-48 a.m.	28:12	8-18 a.m.	29:12	1	- 56.0 : 9	0	0	Remarkable absence of all trace of blasting.	H
572	"	8-18 a.m.	29:12	8-10 a.m.	30:12	1	- 56.5 : 9	0	0	Tests show seismograph fully sensitive.	H
573	"	8-11 a.m.	30:12	8-05 a.m.	31:12	1	- 57.5 : 9	0	0	B. Some trace LS. blasting (?) at 3:30 p.m. on 30th.	H
574	"	8-07 a.m.	31:12	8-51 a.m.	1:1	1	- 58.0 : 9	0	0	Quiescent record. Good line. Tests OK.	H

NOTE:- The entire series 559-574 is remarkable in showing practically no sign of blasting at Lake Shore or at Teck Hughes. Deflection tests and line intensity were satisfactory throughout.

T A B L E IV

°

Larger Rock Bursts Located and
Listed by Lake Shore Mines

°

T A B L E IV

The disturbances are classified as Strain and Crush bursts and the latter are further subdivided into Heavy, Medium and Light. The distinctions are not sharply defined. A strain burst is supposed simply to release strain in the rock. It may, however, cause rock slides, or sections of the surface of the workings may spall off. A crush burst, on the other hand, is one in which the rock of a pillar, large or small, is completely broken down. The terms, heavy, medium, and light are the estimates of the miners and indicate the integrated impressions given by the noise and shock experienced and the damage done. There are no precise criteria. The terms were not used in the reports received at Ottawa until after the end of March.

In the tabulation the strain or crush bursts are combined into one chronological series. The numbers followed by S indicate strain bursts, those followed by C are the crush bursts. The table shows the serial numbers of the S and C series, the date, the Eastern Standard time as reported by the miners, a rough indication of the location, and an estimate of the number of tons of rock displaced. The mine reports give many other details which are not useful here and are accompanied by plans and elevations of the sections of the mine affected.

The capital letters, H, M, or L, appended to a C-serial number in the first column indicate respectively a heavy, medium or light burst, as 243C-H. The capital letters elsewhere in the columns refer to a series of explanations given at the end of the tabulation.

T A B L E IV

Larger Rock Bursts Located and Listed by Lake Shore Mines

Serial No.	Date	Time	Location	Displacement	Remarks
292S	Jan. 4	1-15 p.m.	3901W	2 tons	Recorded
293S	" 16	8-15 p.m.	4301W	slight	No trace
294S	" 18	10-50 p.m.	3202W	total	Recorded
			3314W	2 tons	
295S	" 18	1-30 a.m.	3018W	total	A
			3202W	9.5 tons	
236C	" 19	12-25 p.m.	2901W	slight	B
296S	" 21	10-00 p.m.	4001W	slight	Recorded
296S+	" 26	C	817E	70 tons	Recorded
297S	Feb. 6	8-05 p.m.	3701W	5 tons	Recorded
237C	" 12	D	3301W	50 tons	Recorded
238C	" 13	10-24 a.m.	3501W	?	Recorded
239C	" 17	?	4202E	?	Recorded
298S	" 17	9-15 a.m.	3214W	1 ton	No trace
240C	" 18	4-00 p.m.	3401W	83 tons	Recorded
241C	March 10	10-45 a.m.	3301W	85 tons	Recorded
299S	" 10	5-10 p.m.	No. 4S	slight	No trace
300S	" 12	1-45 p.m.	4201W	.5 ton	No trace
242C	" 27	E	3701W	?	F
301S	April 6	12-55 a.m.	3214E	total	No trace
			3307W	8 tons	
243C-H	" 9	11-50 p.m.	3001W	total	Recorded
			3002W	253 tons	
			3010W		
			3025W		
			3201W		
			3202W		
			3214W		
244C-H	" 12	5-45 a.m.	4002E	G	Recorded
302S	" 16	7-10 p.m.	3002W	12 tons	Recorded
245C-L	" 18	2-45 p.m.	4202E	50 tons	H
246C-L	" 27	10-30 a.m.	5001W	60 tons	No trace
247C-L	" 29	1-50 a.m.	3401W	20 tons	I
303S	May 3	J	4202E	5 tons	No trace
304S	" 15	2-50 p.m.	3307W	50 tons	Recorded
305S	" 16	K	4001W	15 tons	No trace
248C-M	" 20	2-55 a.m.	3401W	total	Recorded
			3406X	220 tons	
			3409W		
			3414W		
249C-L	" 20	8-45 p.m.	4001W	150 tons	Recorded
306S	" 23	8-00 p.m.	4301W	5 tons	Recorded
307S	" 23	9-55 p.m.	4202E	20 tons	Recorded
308S	June 5	1-45 a.m.	3307W	8 tons	No trace
309S	" 5	10-25 a.m.	4001W	2 tons	No trace
250C-L	" 12	9-20 a.m.	4301W	10 tons	No trace
251C-M	" 13	2-45 a.m.	3802E	total	Recorded
			3902E	170 tons	
310S	" 15	L	4001W	20 tons	M
252C-M	" 20	1-25 a.m.	3301W	total	Recorded
			3401W	40 tons	
			3501W		
311S	" 28	2-41 a.m.	4201W	5 tons	Recorded
253C-M	" 29	2-40 a.m.	4001W	total	Recorded
			4201W	75 tons	
312S	July 10	N	4001W	50 tons	O
313S	" 17	2-30 a.m.	No. 6S	23 tons	No trace
314S	" 21	3-00 p.m.	4202E	10 tons	P

Larger Rock Bursts Located and Listed
by Laks Shore Mines

Serial No.	Date	Time	Location	Displacement	Remarks
3F5S	July 22	9-00 p.m.	Q	.5 ton	No trace
254C-L	" 23	3-00 p.m.	4502E	R	No trace
316S	" 23	2-40 p.m.	No. 6S	total	Recorded. S.
"	" 24	8-30 a.m.	"	10 tons	No trace
317S	" 25	3-00 p.m.	4202E	R	Recorded
318S	" 29	3-48 a.m.	No. 6S	10 tons	No trace
255C-H	" 30	9-39 p.m.	3901W	T	Recorded
"	" 30	9-46 p.m.	3908W 4001W 4201W 4301W	T	Recorded
319S	Aug. 1	8-15 p.m.	U	20 tons	No trace
256C-L	" 12	3-05 p.m.	3802E 3902E	total 20 tons	Recorded
257C-L	" 16	D	4301W	40 tons	Recorded
320S	" 26	2-45 p.m.	No. 6S	-	No trace
258C-L	" 29	6-15 p.m.	4402E 4502E	total 60 tons	Recorded
321S	Sept. 3	D	3307W	8 tons	Recorded
322S	" 10	2-35 a.m.	No. 6 S	10 tons	Recorded
259C-L	" 11	1-20 p.m.	V	72 tons	Recorded
323S	" 18	3-20 a.m.	3906E	R	Recorded
260C-H	" 20	2-30 a.m.	4302E 4401E 4402E 4501E 4502E	"Several tons in each place"	Recorded
261C-M	" 21	1-45 p.m.	4402E 4502E	total 100 tons	Recorded
262C-L	" 23	9-40 p.m.	2401W 2501W 2504W 2575X	total 60 tons	Recorded
263C-L	" 27	3-00 p.m.	4201W 4301W	?	Recorded
324S	Oct. 8	9-25 a.m.	3325X	8 tons	Recorded
325S	" 9	3-05 a.m.	5401W	.5 ton	No trace
264C-L	" 11	3-10 a.m.	4002E 4202E	total 170 tons	Recorded
326S	" 21	10-30 p.m.	4301W	15 tons	Recorded ? W
265C-M	" 24	3-01 a.m.	4202E	X	Recorded
266C-L	" 24	4-27 a.m.	4200X	40 tons	Recorded
327S	" 24	7-00 a.m.	3307W	20 tons	Y
328S	" 25	7-15 p.m.	No. 6S	2 tons	No trace
328Sx	" 28	10-26 p.m.	3202W	total	Recorded
"	" 28	11-15 p.m.	"	35 tons	Recorded
329S	Nov. 14	D	4001W	20 tons	Recorded
330S	" 17	10-30 a.m.	4502E	1 ton	Recorded ? Z
267C-M	" 19	10-30 a.m.	4409X 4501E	total 50 tons+	Recorded
268C-M	Dec. 7	8-40 a.m.	4501E 4502E	total 125 tons	Recorded

REMARKS

A. If dates are correct the serial numbers 294S and 295S are inverted. At 1-30 a.m. on the 19th, which might

possibly be intended for 295S, there was no trace.

B. The seismograph not recording at this time, due to lamp failure.

C. Time reported simply as "between shifts". The report was not included in the regular S series and has been assigned the number 296S+ by the writer.

D. Time reported as "between shifts p.m."

E. Reported simply as "between shifts".

F. Adjustment of apparatus interfered with the record during the p.m. off-shift period. There was no trace on the a.m. off-shift period.

G. "Several hundred tons".

H. Recorded very feebly.

I. It is not certain that this was recorded. There was no trace at the time and date given but if either were in error it might have been the record at 2-28 a.m. on the 29th or at 1-46 a.m. on the 30th.

J. Time given as "between day and night shifts".

K. Time given as "between 3 a.m. and 7 a.m."

L. Time given as "between Saturday night and Monday day shift".

M. Either No. 116 or No. 117 of Table V might be 310S.

N. Time given as "3 to 7 p.m."

O. Two bursts at 3.00 and 3.01 p.m., which are probably to be identified jointly as 312S.

P. Small offset at 2-24 p.m. on 21st. may be 314S, but the record is very feeble and the time does not agree well with the reported "3 p.m."

Q. Level 5200 in pilot raise of No. 6 shaft.

R. "Several tons".

S. "Five bursts of which three were heavy".

T. The damage due to these bursts (there were three) was great. The displacement is reported as "210 tons + several hundred tons + 30 tons + small amount".

U. "No. 4 shaft at 5325' level".

V. "Pillar between 2722 and 2725X cuts". Note the very small half-amplitude on the surface seismograph (5 half mm.) for a displacement of 72 tons.

W. See Note N of Table V.

X. "Several tons" and "30 tons".

Y. Not recorded, but may have occurred while sheets were being changed 7-06-30 to 7-07-30 a.m.

Z. See Note O of Table V.

*

T A B L E V

Rock Bursts Recorded on Surface Seismograph

T A B L E V

The tabulation includes all those offsets on the mine seismograph record which had a half amplitude of at least three millimeters. In a few cases offsets of only two millimeters (half amplitude) were included when it was definitely known that they were due to rock bursts.

The table gives, in order, the serial number here assigned for the purpose of referring to this list, the serial number of the seismogram on which the offset was recorded, the Eastern Standard Time of the burst to the nearest minute as read from the corrected time of the seismogram (on the 24-hr. system beginning at midnight), the half amplitude in half millimeters as read from the seismogram, a rough approximation to the duration in seconds, and, finally, the Lake Shore number in the S or C series if the offset was identified with a listed burst.

It is here to be noted that the sensitivity of the seismograph varied a small but unknown amount from time to time during the year so that the records are not strictly comparable. Since the testing device was introduced on August 4, there has been a daily check on sensitivity and the variation found is, in general, negligible. Just what variation there may have been earlier in the year is not known.

With regard to the offsets of maximum amplitude, it is to be noted that no offset can have a greater amplitude than that determined by the cylindrical lens. Prior to March 17 only half of this lens was in use. After that date the full lens was used to indicate half amplitude. But, under these new conditions, the zero position of the semaphore determines the used length of lens and this has changed slightly at each adjustment. It may safely be assumed that the amplitude indicated for bursts of more than one second were as great as the instrument could give and are not an indication of true relative displacement.

Some of the blasting gave offsets almost as great as those included in the list. A few of the known bursts, with half amplitudes less than three millimeters, are of lesser amplitude than some blasting. It may be assumed that the tabulation includes all bursts of importance and excludes most, if not all, of the blasting. It is thus a minimum list of the bursts for which the combination of intrinsic energy release and distance attenuation permitted a registration on the seismograph at its present surface location. As noted elsewhere, many of these disturbances may have occurred in mines other than Lake Shore.

TABLE V

Rock Bursts Recorded on Surface Seismograph

No.	Seismogram	Date	Time	Half-amp.	Duration	LS. No.	Remarks
1	198	Jan. 1	21-16	8	1	-	-
2	"	" 2	1-44	4	1	-	-
3	"	" 2	9-57	4	1	-	-
4	199	" 3	2-14	12	1	-	-
5	200	" 4	13-10	6	1	292S	-
6	202	" 6	10-53	3	1	-	-
7	204	" 8	13-09	15	1	-	-
8	208	" 12	2-06	13	1	-	-
9	214	" 18	10-20	8	1	-	-
10	"	" 18	10-47	25	1	294S	-
11	216	" 20	22-36	7	1	-	-
12	"	" 21	1-58	7	1	-	-
13	"	" 21	10-03	6	1	-	-
14	"	" 21	14-47	5	1	-	-
15	217	" 21	22-02	7	1	296S	-
16	218	" 23	14-49	9	1	-	-
17	220	" 25	14-54	8	1	-	-
18	221	" 26	1-43	42	2	296S+	-
19	223	" 27	22-33	25	1	-	-
20	226	" 31	15-05	6	1	-	-
21	227	" 31	23-22	6	1	-	-
22	"	Feb. 1	15-06	7	1	-	-
23	230	" 4	2-23	7	1	-	-
24	231	" 5	2-29	8	1	-	-
25	232	" 5	18-02	8	1	-	-
26	233	" 6	20-06	11	1	297S	-
27	235	" 8	3-15	15	1	-	-
28	237	" 10	15-47	10	1	-	-
29	238	" 11	14-58	13	1	-	-
30	"	" 11	15-04	23	2	-	-
31	239	" 12	15-41	13	1	237C	-
32	"	" 13	10-24	34	3	238C	-
33	243	" 17	5-11	18	2	239C	-
34	245	" 18	15-35	14	2	-	-
35	"	" 18	16-03	32	3	240C	-
36	"	" 18	16-03	10	1	-	-
37	250	" 23	14-57	25	2	-	-
38	251	" 24	13-15	6	1	-	-
39	"	" 24	13-49	23	2	-	-
40	252	" 25	13-47	6	1	-	-
41	254	" 27	19-16	7	1	-	-
42	256	March 1	22-35	30	1	-	-
43	258	" 4	2-53	14	1	-	-
44	259	" 5	6-29	14	1	-	-
45	264	" 10	10-51	33	2	241C	-
46	265	" 11	4-45	33	2	-	-
47	269	" 14	14-45	11	1	-	-
48	"	" 14	14-48	11	1	-	-
49	270	" 15	14-01	8	1	-	-
50	272	" 17	14-35	7	1	-	-
51	273	" 18	18-41	29	3	-	-
52	274	" 19	1-48	10	1	-	-
53	"	" 19	2-56	17	1	-	A
54	282	" 24	22-30	10	1	-	-
55	290	" 28	2-31	8	1	-	-
56	291	" 29	14-31	8	1	-	-
57	"	" 29	15-05	9	1	-	-
58	292	" 31	6-04	19	1	-	-
59	293	" 31	18-23	13	1	-	-

Rock Bursts Recorded on Surface Seismograph

No.	Seismogram	Date	Time	Half-amp.	Duration	LS. No.	Remarks
60	297	April 3	2-45	21	1	-	-
61	301	" 5	22-12	27	2	-	-
62	305	" 9	14-52	16	1	-	B
63	307	" 9	23-51	31	12	243C-H	C,D
64	309	" 12	5-47	31	30	244C-H	B,C
65	310	" 13	8-13	31	2	-	C
66	313	" 16	1-07	14	1	-	-
67	314	" 16	14-33	21	1	-	B
68	"	" 16	19-05	6	1	302S	-
69	"	" 17	2-35	20	1	-	-
70	315	" 17	21-34	5	1	-	-
71	"	" 18	14-34	2	1	245C-L	-
72	316	" 19	0-59	12	1	-	-
73	"	" 19	2-23	12	1	-	-
74	"	" 19	14-29	13	1	-	-
75	317	" 19	22-32	16	1	-	B
76	"	" 20	6-20	7	1	-	-
77	318	" 20	17-15	11	1	-	-
78	320	" 22	21-21	15	1	-	B
79	322	" 25	15-12	11	1	-	B
80	323	" 25	21-24	11	1	-	-
81	324	" 26	21-03	12	1	-	-
82	326	" 28	22-14	11	1	-	-
83	"	" 29	2-28	24	1	247C(?)	E
84	"	" 29	22-29	10	1	-	-
85	327	" 30	1-46	7	1	247C(?)	E
86	328	" 30	21-19	11	1	-	B
87	"	May 1	6-23	15	1	-	-
88	330	" 3	11-28	13	1	-	-
89	337	" 10	14-44	6	1	-	B
90	"	" 10	15-18	10	1	-	-
91	341	" 14	2-48	28	2	-	-
92	"	" 14	6-34	29	3	-	-
93	342	" 15	14-50	14	1	304S	-
94	343	" 16	9-17	14	1	-	-
95	"	" 16	12-16	27	1	-	-
96	344	" 17	14-44	7	1	-	-
97	345	" 17	23-24	23	2	-	-
98	347	" 20	2-52	29	1	248C-M	-
99	348	" 20	20-46	6	1	249C-L	-
100	351	" 23	19-53	4	1	306S	-
101	"	" 23	21-33	20	2	307S	-
102	"	" 24	12-14	15	1	-	-
103	355	" 28	7-08	4	1	-	-
104	356	" 29	10-36	4	1	-	-
105	363	June 5	2-33	8	1	-	-
106	364	" 5	14-37	7	1	-	-
107	"	" 5	14-56	5	1	-	-
108	"	" 5	22-15	5	1	-	-
109	"	" 6	3-25	5	1	-	-
110	365	" 7	5-56	4	1	-	-
111	368	" 9	21-11	19	3	-	-
112	"	" 9	21-13	15	2	-	-
113	"	" 10	2-19	6	1	-	-
114	370	" 12	1-14	8	1	-	-
115	371	" 13	2-43	19	7	251C-M	-
116	373	" 15	2-42	15	2	310S(?)	F
117	374	" 15	20-49	8	1	310S(?)	F
118	375	" 16	15-12	6	1	-	-

Rock Bursts Recorded on Surface Seismograph

No.	Seismogram	Date	Time	Half-amp.	Duration	LS. No.	Remarks
119	377	Jun. 19	2-50	12	2	-	-
120	378	" 20	1-29	18	7	252C-M	-
121	"	" 20	2-22	11	1	-	-
122	"	" 20	2-56	16	2	-	-
123	379	" 20	14-57	17	2	-	-
124	"	" 21	0-26	8	1	-	-
125	381	" 22	10-49	16	1	-	-
126	383	" 24	10-57	8	1	-	-
127	"	" 25	4-30	25	2	-	-
128	385	" 27	5-35	26	2	-	-
129	386	" 28	2-41	13	1	311S	-
130	387	" 29	2-39	24	3	253C-M	-
131	390	Jul. 1	11-07	6	1	-	-
132	392	" 3	14-35	9	1	-	B
133	"	" 3	21-06	14	1	-	-
134	"	" 3	23-08	7	1	-	-
135	393	" 5	2-55	13	1	-	-
136	394	" 5	16-37	12	1	-	-
137	395	" 6	17-16	17	1	-	-
138	398	" 9	14-09	5	1	-	-
139	"	" 9	14-52	22	1	-	-
140	"	" 9	17-53	13	1	-	-
141	"	" 9	22-27	6	1	-	-
142	"	" 10	0-48	26	1	-	-
143	399	" 10	15-00	7	1	312S	G
144	"	" 10	15-01	7	1	312S	G
145	401	" 12	14-18	6	1	-	-
146	"	" 12	14-25	6	1	-	-
147	"	" 12	15-50	25	3	-	-
148	"	" 12	15-52	10	1	-	-
149	"	" 12	15-57	9	1	-	-
150	"	" 12	17-08	5	1	-	-
151	402	" 13	20-57	12	1	-	-
152	403	" 14	14-35	5	1	-	-
153	"	" 14	15-01	5	1	-	-
154	"	" 14	15-04	9	1	-	-
155	404	" 16	2-13	9	1	-	-
156	405	" 16	14-49	5	1	-	-
157	"	" 17	2-17	7	1	313S	-
158	406	" 18	1-37	4	1	-	-
159	"	" 18	1-41	20	1	-	-
160	"	" 18	2-22	23	1	-	-
161	407	" 19	2-51	12	1	-	-
162	409	" 20	23-41	8	1	-	-
163	410	" 21	14-24	6	1	-	-
164	"	" 21	15-17	7	1	314S	-
165	411	" 22	14-38	5	1	-	B
166	412	" 23	14-41	12	1	316S	H
167	413	" 24	13-25	9	1	-	-
168	415	" 25	15-17	14	2	317S	-
169	"	" 26	2-54	8	1	-	-
170	416	" 26	22-28	5	1	-	-
171	417	" 28	5-31	25	2	-	-
172	418	" 28	17-07	10	1	-	B
173	"	" 28	23-13	5	1	-	-
174	"	" 29	0-32	25	3	-	-
175	419	" 29	14-46	8	1	-	-
176	420	" 30	21-39	25	8	255C-H	I
177	"	" 30	21-39	24	7	255C-H	-
178	"	" 30	21-46	24	20	255C-H	-

Rock Bursts Recorded on Surface Seismograph

No.	Seismogram	Date	Time	Half-amp.	Duration	LS. No.	Remarks
179	422	Aug. 2	2-54	25	2	-	-
180	425	" 4	22-24	11	1	-	-
181	429	" 8	16-53	33	2	-	J
182	431	" 10	11-51	6	1	-	-
183	"	" 10	12-16	5	1	-	-
184	433	" 12	15-13	14	1	256C-L	B
185	"	" 12	22-46	17	1	-	-
186	436	" 15	10-29	5	1	-	-
187	437	" 16	14-39	19	1	257C-L	B,K
188	438	" 17	14-41	12	1	-	-
189	"	" 18	2-14	4	1	-	-
190	440	" 19	3-48	38	2	-	B
191	"	" 20	4-59	14	1	-	-
192	"	" 20	5-00	11	1	-	-
193	"	" 20	6-29	5	1	-	-
194	441	" 20	19-02	58	12	-	B,L
195	442	" 22	2-31	6	1	-	-
196	443	" 22	18-28	30	1	-	-
197	"	" 22	20-04	5	1	-	-
198	"	" 22	21-27	18	1	-	-
199	444	" 24	5-30	9	1	-	-
200	445	" 24	21-32	58	2	-	-
201	449	" 29	2-05	58	2	-	-
202	450	" 29	14-31	13	1	-	-
203	"	" 29	18-41	7	1	258C-L	-
204	455	Sept. 3	14-35	5	1	321S(?)	M
205	"	" 3	14-55	17	1	321S(?)	M
206	458	" 6	12-55	6	1	-	B
207	"	" 6	17-57	7	1	-	-
208	459	" 7	13-52	20	1	-	-
209	460	" 8	12-27	18	1	-	-
210	461	" 10	2-32	7	1	322S	-
211	462	" 10	11-32	7	1	-	-
212	"	" 10	17-56	6	1	-	-
213	463	" 11	13-19	5	1	259C-L	-
214	464	" 12	23-44	17	1	-	-
215	467	" 15	15-02	5	1	-	-
216	468	" 16	13-56	17	1	-	-
217	"	" 16	13-57	17	1	-	-
218	469	" 18	3-18	58	8	323S	-
219	470	" 18	22-27	5	1	-	-
220	"	" 18	23-59	58	2	-	-
221	"	" 19	2-31	7	1	-	-
222	471	" 19	14-58	6	1	-	-
223	"	" 19	19-23	12	1	-	-
224	"	" 20	2-31	56	20	260C-H	-
225	472	" 20	14-43	9	1	-	-
226	473	" 21	13-56	58	3	261C-M	-
227	475	" 23	21-37	58	5	262C-L	-
228	476	" 24	14-41	6	1	-	-
229	477	" 25	19-14	13	1	-	B
230	"	" 25	22-36	14	1	-	-
231	479	" 27	14-58	58	3	263C-L	-
232	481	" 29	14-47	7	1	-	-
233	"	" 29	14-52	5	1	-	-
234	"	" 29	22-21	14	1	-	-
235	"	" 29	22-26	4	1	-	-
236	482	Oct. 1	2-31	5	1	-	-
237	"	" 1	2-31	15	1	-	-
238	484	" 2	20-34	4	1	-	-

Rock Bursts Recorded on Surface Seismograph

No.	Seismogram	Date	Time	Half-amp.	Duration	LS. No.	Remarks
239	484	Oct. 2	22-19	9	1	-	-
240	"	" 2	22-26	10	1	-	-
241	"	" 3	3-09	9	1	-	-
242	"	" 3	4-08	20	1	-	-
243	"	" 3	6-31	6	1	-	-
244	486	" 4	22-08	54	2	-	-
245	"	" 4	22-08	48	1	-	-
246	"	" 4	22-12	5	1	-	-
247	"	" 4	22-29	8	1	-	-
248	"	" 5	3-48	31	1	-	-
249	"	" 5	6-46	11	1	-	-
250	487	" 5	17-07	7	1	-	-
251	488	" 6	13-12	26	1	-	-
252	"	" 6	20-11	16	1	-	-
253	490	" 8	9-24	44	1	324S	-
254	491	" 9	14-47	16	1	-	-
255	"	" 9	22-33	8	1	-	-
256	492	" 11	3-10	50	1	264C-L	-
257	"	" 11	3-10	12	1	264C-L	-
258	"	" 11	3-14	40	1	264C-L	-
259	495	" 13	14-06	13	1	-	-
260	496	" 14	15-08	19	1	-	-
261	"	" 15	0-12	11	1	-	-
262	497	" 16	3-46	7	1	-	-
263	500	" 18	13-07	11	1	-	-
264	502	" 21	6-09	4	1	-	-
265	503	" 21	22-10	4	1	326S(?)	N
266	504	" 22	15-01	11	1	-	-
267	"	" 22	16-25	14	1	-	-
268	505	" 24	3-02	31	2	265C-M	-
269	"	" 24	4-28	14	1	266C-L	-
270	507	" 25	21-13	8	1	-	-
271	509	" 27	22-19	11	1	-	-
272	"	" 28	2-57	5	1	-	-
273	510	" 28	22-25	58	4	328Sx	-
274	"	" 28	23-15	58	4	328Sx	-
275	"	" 29	2-09	10	1	-	-
276	511	" 30	1-54	11	1	-	-
277	513	" 31	11-57	5	1	-	-
278	514	Nov. 1	14-51	34	1	-	-
279	"	" 2	2-43	34	1	-	-
280	518	" 5	10-49	9	1	-	-
281	"	" 5	15-13	4	1	-	-
282	519	" 6	8-16	42	1	-	-
283	"	" 6	13-25	8	1	-	-
284	521	" 8	14-05	12	1	-	-
285	523	" 10	14-26	15	1	-	-
286	"	" 10	14-27	10	1	-	-
287	527	" 14	16-28	17	1	329S	-
288	528	" 15	22-04	36	1	-	-
289	"	" 16	3-04	58	1	-	-
290	529	" 16	10-35	58	1	330S(?)	O
291	"	" 17	4-15	14	1	-	P
292	530	" 18	2-41	10	1	-	-
293	531	" 18	22-46	50	2	-	-
294	"	" 18	22-46	14	1	-	-
295	"	" 18	23-16	10	1	-	-
296	532	" 19	10-30	55	3	267C-M	-
297	"	" 19	10-30	23	1	267C-M	-

Rock Bursts Recorded on Surface Seismograph

No.	Seismogram	Date	Tims	Half-amp.	Duration	LS. No.	Remarks
298	537	Nov. 24	10-42	14	1	-	-
299	544	Dec. 1	16-03	55	1	-	-
300	549	" 7	7-04	6	1	-	-
301	"	" 7	8-39	58	5	268C-M	-
302	557	" 14	20-23	11	1	-	-
303	558	" 16	3-25	16	1	-	-
304	562	" 19	10-00	50	1	-	-
305	565	" 22	16-20	18	1	-	-
306	567	" 24	9-10	11	1	-	-

REMARKS

A. Seismogram No. 275 (Mar. 20-21) shows a large number of offsets resembling bursts; but, as adjustments were being made from time to time during the record period, it cannot be certain which are caused by the operator and which, if any, are due to bursts. On seismogram No. 287 (Mar. 27-27) two offsets appear also at a time when they might have been caused by the operator.

B. Unusually heavy blasting on this record.

C. The recorded half-amplitude of 31 half-millimeters is probably as great as the equipment could record (see note preceding Table V, Paragraph 4) at the period of this record. Compare Note J.

D. There was some unusually heavy blasting on seismogram No. 308 (Apr. 10-11). Some of the offsets recorded in blasting time may have been due to bursts.

E. It may be that 247C-L is represented by 83 or 85 or neither. See Note I of Table IV.

F. Burst 310S was reported as "Between Saturday night and Monday day shift" on June 15 (Sunday).

G. The time reported for 312S was given as "3-7 p.m." The two offsets (143-144) can probably be identified jointly with 312S.

H. The offset at 14-41 on July 23 might be 254C-L on July 23 at "3 p.m." or 316S on the same date at "2-40 p.m." It has been identified as the latter. This leaves the record with no trace of the crush burst 254C-L.

I. Heavy burst in three parts. The first and last registered at Ottawa and at Shawinigan Falls, Que.

J. The testing device shows that the maximum recording half-amplitude is at least 40 half-millimeters (See Nos. 194, 200 and 201) at this period of operation. Compare Note C.

K. The discrepancy in time from "3 to 7 p.m." given in the mine report and the 14-39 of the seismogram is rather great but as the burst was fairly severe (40 tons

displacement) and no other offset appears on the record of the seismograph which was evidently in good order, it seems safe to conclude that they are to be identified as the same disturbance.

L. Reported to have occurred in Teck-Hughes.

M. Time reported was "between shifts p.m." Presumably 205 is to be identified with 321S but it might be 204.

N. Discrepancy of 20 min. in time and recorded amplitude is large but there is no other offset which may be identified as 326S for which the displacement was 15 tons.

O. Burst 330S is reported as 10-30 a.m. on 17th. There is no trace of an offset at that time. It is possible that No. 290 at 10-35 a.m. on the 16th might be so identified.

P. Miners went on strike on November 17.

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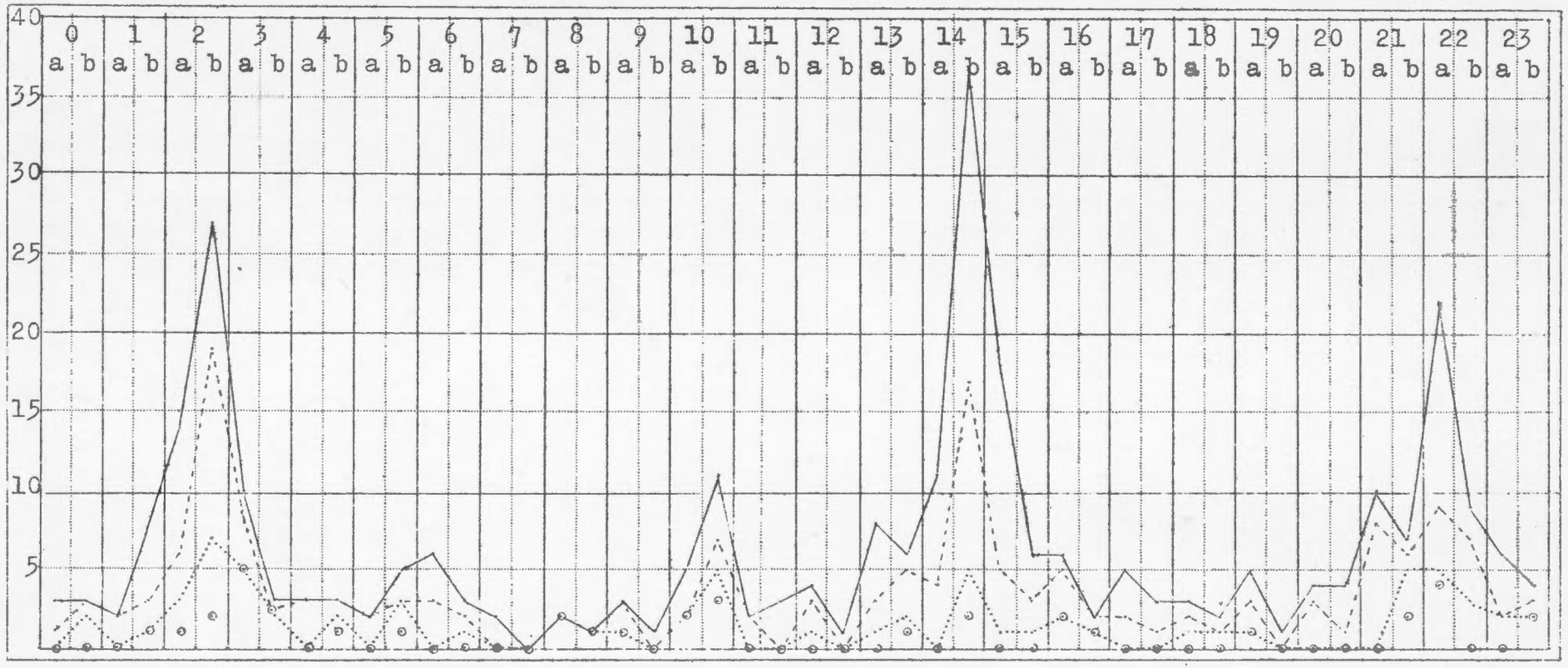
The following analysis of the data of Table V is of interest. The bursts are classified on the basis of the time of occurrence and intensity. The time is reckoned on the twenty-four hour system, beginning at midnight as 0 hr. The intervals are half hours, as 0-00 to 0-29; 0-30 to 0-59; etc. The intensities are the four categories defined in Section 5.

	0a	0b	1a	1b	2a	2b	3a	3b	4a	4b	5a	5b
A,B,C,D	3	3	2	8	14	27	10	3	3	3	2	5
B,C,D	1	3	2	3	6	19	8	2	3	3	2	3
C,D	0	2	0	1	3	7	5	2	0	2	0	3
D	0	0	0	1	1	2	5	2	0	1	0	1

	6a	6b	7a	7b	8a	8b	9a	9b	10a	10b	11a	11b
A,B,C,D	6	3	2	0	2	1	3	1	5	11	2	3
B,C,D	3	2	0	0	2	1	3	0	2	7	2	0
C,D	0	1	0	0	2	1	1	0	2	5	0	0
D	0	0	0	0	2	1	1	0	2	3	0	0

	12a	12b	13a	13b	14a	14b	15a	15b	16a	16b	17a	17b
A,B,C,D	4	1	8	6	11	37	18	6	6	2	5	3
B,C,D	3	0	3	5	4	17	5	3	5	2	2	1
C,D	1	0	1	2	0	5	1	1	2	1	0	0
D	0	0	0	1	0	2	0	0	2	1	0	0

	18a	18b	19a	19b	20a	20b	21a	21b	22a	22b	23a	23b
A,B,C,D	3	2	5	1	4	4	10	7	22	9	6	4
B,C,D	2	1	3	0	3	1	8	6	9	7	2	3
C,D	1	1	1	0	0	0	0	5	5	3	2	2
D	0	0	1	0	0	0	0	2	4	1	1	2



Intensity-Distribution Analysis

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The above chart presents graphically the data of the preceding page. The abscissae divide the 24-hr. interval into half-hour periods. The number of offsets on the surface seismograms is plotted for each half hour (0-00 to 0-29; 0-30 to 0-59; etc.), the plotted points being placed in the centre of the abscissae spaces. The ordinate numbers (5,10,. . 40) are the number of offsets in each time interval. The unbroken line represents the sum of all the offsets (A+B+C+D); the dash line the sum of the last three (B+C+D); the dotted line the sum of the last two (C+D); and the circles the numbers in the last class (D) only.

It will be noted that the bursts show a marked correlation with Lake Shore blasting times; and a lesser, but definite, correlation with the blasting at Teck-Hughes. Further, this correlation shows up clearly for each of the graph lines and for the plotted D-points.