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SEISMIC RESEARCH PROGRAM  
ROCK BURST PROBLEM  
LAKE SHORE MINES

Report No. 4  
Surface Seismograph Records  
Dec. 19'39 - Dec. 31'40

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Ernest A. Hodgson

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Ernest A. Hodgson

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Report No. 4

Surface Seismic Recording  
Dec. 19'39 - Dec. 31'40

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Ernest A. Hodgson

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Three previous reports have outlined the progress of the rock burst research at Lake Shore Mines, Kirkland Lake, up to and including August 15, 1940. The second and third deal mostly with conditions or studies underground, and a forthcoming report (No. 5), now in preparation, will bring the account of that part of the work to date. Report No. 1 describes the initial, surface (Heiland) seismograph and its installation. The appendix to Report No. 2 gives details regarding a (mine) seismograph designed and built at Ottawa for use underground during March, 1940. This instrument was, however, used for routine surface recording from April 1 to July 6, while the recorder of the Heiland instrument was undergoing changes and repairs at Ottawa. Samples of records obtained (underground) with this interim equipment (mine seismograph) are given as Figs. 23 and 24 of Report No. 2. It does not seem necessary to give samples of its surface records, which are much the same but with less violent offsets, since the equipment was farther removed from the sources of disturbance. The third report outlines the changes made in the Heiland recorder and gives a section of a record obtained there-with on the surface. This shows a well-defined record of a rock burst (Fig. 17).

The records made by the original surface equipment are numbered consecutively (1-109) as Series I (Dec. 19'39 to March 31'40). The records made on surface with the mine seismograph are identified as Nos. 19-113 of Series II. (The first 18 records of this series were obtained underground in March and are discussed in Report No. 2.) The routine records (19 to 113) were made regularly, on surface, from April 1 to July 6. Series III comprises the records made with the re-conditioned surface seismograph. Nos. 1-196 of this series cover the period from July 2 to December 31. It will be noted that there is a slight overlap (July 2-6) of Series II and III. Both installations operated together on surface for these few days.

The present report discusses the records made in the course of the regular surface recording from December 19, 1939, when the work began, to the end of December, 1940. A brief but comprehensive summary will be given first, followed by discussion of the data under various headings. A tabular record (Table III) of the entire set of individual seismograms, prepared in accordance with the initial form as given in the final appendix to Report No. 1, completes this report.

1. Summary Discussion: The maintainence of a surface seismograph at Lake Shore Mines can, at best, serve only two purposes: (a) furnish data for an accurate determination of the velocity of propagation of elastic waves in the upper surface layers (a matter of considerable value from a purely scientific point of view) and (b) provide a complete record of the rock burst activity over a period of years and determine whether it is growing or not.

To accomplish the first, it is necessary that the absolute time of all large bursts be known to within a half second, or less if possible. Any interruption to the seismograph or its auxiliary time equipment is fraught with the possibility of losing the data, for the obtaining of which opportunities are so rare. An analysis of the "lost time" for the period of this report is given in Section 2. The information is tabulated for study in Table I. The total percentage time loss has been found to be 6.14 per cent. This is more than should be the case in 1941. It is hoped that the percentage loss for the present year will not exceed 2.5 per cent.

If the first purpose is to be fully attained, the chronometer correction must be obtained accurately and regularly. The time comparisons have been tabulated in Table III and are discussed in Section 3 and Table II. They have been satisfactory on the whole, but not as good at all times as they might have been. It would be an advantage if the operator were to plot his time correction day by day and enter in the notes on the back of current seismograms any observed abnormalities and any changes of rate, together with what he considers might have caused them. Some of the desk memoranda of time comparisons would never have been sent had the operator plotted them.

All adjustments affecting the chronometer and its rate should be described at once with sufficient detail on the back of the corresponding seismogram. Only in this way can one obtain a complete and accurate time correction graph.

If the second purpose -- studies of rock burst incidence -- is to be attained, there must be prompt, regular and careful correlation with the seismograms of data from the underground superintendent's office. A glance over the comments in Table III will serve to indicate how sporadic and inadequate has been the correlation for most of the time covered by this report. Some attempt has been made in Section 4 to analyze the rock burst data but its weakness is as evident as is the source of that weakness.

In conclusion, it may be stated that, except for the lost time discussed in Section 2, the surface seismograph has operated in such a manner that all bursts of even moderate intensity have been recorded and timed with an error which is in general  $\pm .5$  sec. and seldom if ever greater than  $\pm 1.0$  sec. So far as the writer knows, no burst of moderate intensity occurred during any lost-time period, and, certainly, no burst large enough to have served for a velocity determination so occurred. Finally, it must be recorded that no velocity determination has been made, as yet, in more than a year of recording. As for the complete tabulation of all

bursts and their relative magnitudes as experienced at the surface station, the service has fallen far short of the possibilities. The interruptions due to required modifications of equipment now seem to be past. The present sensitivity seems quite adequate. Although it is not so high for Series III as it was for Series I, the recording seems to be a better indication of burst activity with less disturbance from adjacent conditions in the gymnasium, etc. The records for 1941 could be much improved with a daily sensitivity test and daily correlation of data. The first of these will be inaugurated in the near future. Some suggestions for improvement of the service are given in Section 5.

No earthquake was registered on the Kirkland Lake seismograph for the period of this report, with the very probable exception of the New Hampshire earthquake of December 20, 1940 at about 2-30 a.m. E.S.T. There seems to be a record of this on the Kirkland Lake sheet for about half a minute.

2. Lost Time: One of the chief reasons for installing and maintaining the surface seismograph is the accurate determination of the speed of propagation of the elastic waves in the upper part of the earth's crust. To obtain this, the Kirkland Lake instrument must be operating at the moment when a burst occurs of sufficient magnitude to register at distant seismographs. Furthermore, to be of any value, the record must carry regular chronometer minute marks and the correction for these must be known.

Hence, should such a burst occur during any moment during which the above complete set of conditions fails, that opportunity for obtaining a velocity measure would be lost. It is important in servicing the seismograph to reduce to the absolute minimum the time during which a burst could not be accurately timed from the record. All such periods may be spoken of as "lost time".

The time required to change the seismograph sheets runs from a few seconds to several minutes. It is a necessary loss, but is nevertheless to be classed as lost time. The time so spent each day has been tabulated in the primary columns of Table I.

There were other causes of lost time which were, in some cases, unavoidable and in others are simply to be classed as due to the carelessness of the operator. These causes have been listed in the legend section of the above table, the actual time lost on account of these various causes being indexed in the body of the table. All entries are to the nearest minute.

There were a few intervals of a day or so for which the chronometer correction is not now known. The exact information as to what was done to the chronometer was not entered and cannot now be learned. However, these intervals have not been entered in the lost time tabulation (to which they properly belong) since, if a severe burst had occurred at this epoch, the operator would, no doubt, have at once made a series of adequate time comparisons.

Where the chronometer signals were not, for any reason,

impressed on the record, the time was irretrievably lost and is therefore included in the tabulation. This is especially serious when due to the chronometer not being wound. Under such circumstances, the time without signals is lost and the chronometer rate is usually affected also.

It will be noted that the total lost time for the period of this report (378<sup>d</sup>12<sup>h</sup>25<sup>m</sup>) amounts to 33509 minutes (23<sup>d</sup>06<sup>h</sup>29<sup>m</sup>) or 6.14 per cent. While this is greater than should be considered normal, it is to be remembered that this was the initial year of operation and that more adjustment of equipment was necessary than will likely be the case in the future. It is hoped that this lost time can be brought down to at least 2.5 per cent for 1941.

3. Chronometer Corrections: Time comparisons between the chronometer and radio signals were made, usually, once a day, though there were a few periods in which the comparisons were somewhat irregular as will be noted in Table III under the heading "Time Correction". In general, the comparisons were good, most of them being automatically recorded on the seismograms. During the interim period of Series II (April 1-July 2), automatic recording was not attempted as the paper speed of the mine seismograph was too slow, - only 8 mm/sec. instead of the 30 mm/sec. of the Heiland recorder. For this period the comparisons were made by eye-and-ear method and a single signal put on the seismogram by means of a telegraph key. The correction, as estimated by looking at the second hand of the chronometer while listening to the radio signal, was also kept as a desk memorandum. A few records were run initially on the re-constructed Heiland recorder at a paper speed of 60 mm/sec.; but this necessitated servicing the instrument twice daily, with consequent double loss of recording time, consumed twice as much paper, and did not yield records sufficiently more accurate to warrant the expense and trouble.

In preparing this report, the chronometer corrections were obtained from the records or from desk memoranda. They were plotted on cross-section paper to a scale .5' inch = 1 second correction and 1 inch = 1 day. Through these plotted points, the graph for the chronometer rate was drawn and all outstanding deviations of plotted points were re-examined on the records.

Table II 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 half a second, 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 chronometer rate seems to have changed from time to time by small amounts. An underline, in the corrections column of Table II, indicates the more marked cases of such change. When the chronometer stopped or was reset and the notes fail to state at what time of day this was done, a question mark (?) appears in this tabulation. To interpolate for a value within the intervals affected, it will be necessary to consult the data of Table III in conjunction with those of Table II for an interval before and after the epoch concerned.

Attention may be drawn to the fact that the re-setting of the chronometer should be done only at long intervals and that extreme care should be taken never to forget to wind it, as these actions seriously affect the value of the surface routine for some hours or even a day or two. Where any changes are made in the chronometer or where the rate is found by the operator to be changing, the local conditions likely to have caused this should be considered and full notes given on the back of the record concerned.

Most of the erratic values of the observed corrections, as plotted on the graph determining the chronometer rate, were evidently due to isolated careless evaluations of the correction. But in some cases the chronometer seems to have lost a half second or more, probably due to careless handling when it was wound. Care should be taken to handle the chronometer carefully and to rotate the key only when winding.

4. Distribution of Bursts: To permit even an approximation to a statistical study of the surface-recorded rock bursts for the period of this report, it would be necessary to have the sensitivity of the seismograph either the same throughout or to have the data permitting a comparison. These conditions do not obtain. The sensitivity was roughly the same throughout each of the three series: Dec. 19'39 to March 31'40 with the original Heiland equipment; April 1 to July 2 with the mine seismograph on surface; July 3 to Dec. 31 with the modified Heiland equipment. Inter-comparison of the sensitivity for the three series cannot be made and it is not certain that the sensitivity was the same throughout any given series. Indeed, in the case of Series I it is certain that the sensitivity was falling off after the middle of February. It is to be noted, however, that at no time (except when the gain was inadvertently set at zero; which time is included in the lost time tabulation) was the instrument so lacking in sensitivity that a moderately-severe burst would not have registered.

To overcome the difficulty described in the preceding paragraph, it is proposed to provide a simple and uniform mechanical test to be applied to the seismograph each day as a matter of routine; thus showing, in some degree at least, the comparative sensitivity of the equipment from day to day.

Another condition which must be met before the records may be used to show comparative burst activity from month to month is that of routine and regular correlation of underground data as to blasting and other activity with the surface records. Unless this is done promptly and regularly, questions of interpretation arise when the records are read

which cannot then be answered. A glance through the comments in Table III will show how few were the periods of regular correlation.

For what they may be worth, the reports of bursts for the period of this report may be tabulated on the following basis. In line A are listed those bursts which were sufficiently severe to have a marked duration period, - of two seconds or more. In line B are listed those, less-severe, which were, however, certainly identified as bursts; and in line C those which were entered with an added question mark drawing attention to the lack of certainty that they really were bursts. The various entries of a question mark (?) only in the bursts column of Table III are not considered in the tabulation.

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=====
Dec. Jan. Feb. Mar. Apr. May. Jun. Jul. Aug. Sep. Oct. Nov. Dec.
-----
A  0  1  4  0  0  0  0  0  2  0  3  3  1
B  2  5  2  16 18  5  4  17 24 40 12 24 14
C  4  57 27 28  2  0  0  17 17 18 29 19 21
=====

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The above tabulation does not mean very much except for the following observations:

- (a) The line A shows 14 fairly large bursts each of which had a duration on the record of 2 seconds or more. This is a minimum list; for, had all records been registered on the original Heiland equipment or even on the final modified Heiland seismograph, the number of larger bursts showing duration would surely have been larger. It is to be noted that not a single entry appears in line A for the months <sup>April</sup> ~~March~~ to June inclusive when the mine seismograph with ink registration and low paper speed was alone in service.
- (b) Where the correlation was poorly done, the number of bursts falling into line C from line A is greater than would otherwise have been the case.
- (c) The entries for Series III (July to Dec. inclusive) were all determined with the modified Heiland equipment at, presumably, the same sensitivity. While light spot conditions varied and the lost time was not uniform in these months; still, the conditions were more nearly uniform and continuous. It may be noted that the number of records identified as bursts varies from 15 to 40 per month. During this period the scanning of the records at Ottawa was done fairly uniformly, all being read in order without interruption. The number of entries in the three lines combined varies from 34 to 58 per month.
- (d) It may be stated that, for the last half of 1940, the number of larger bursts ranged from 0 to 3 per month and that none of these was sufficiently severe to register at Ottawa. The large burst in line A for December occurred on December 28 and at a time when the Benioff



at Ottawa was dismantled for adjustment. It was not, however, registered on the short period seismograph at Shawinigan Falls. Previous experience shows that a burst registered at Ottawa is also registered at Shawinigan on a slightly smaller scale. It may be inferred that if the burst could have registered at Ottawa the amplitude would have been so small as to have precluded the possibility of making a velocity determination.

5. Suggestions for Improvement of Service:

- (a) The operator should read and avoid where possible the sources of lost time experienced in 1940, as given in the legend of Table I.
- (b) Sheets should be replaced on the drum with a minimum loss of time even though adjustments may be found necessary on developing the sheet just removed. It is better to use an extra sheet than to leave the equipment non-recording even for a short time.
- (c) When a record covers only an hour or so between two regular sheets but does so adequately, it should be included in the records sent as a proof of coverage.
- (d) Correlation of sheets with mine data should be done promptly and regularly and all offsets on the record explained or marked as due to unknown sources.
- (e) Records should be sent to Ottawa regularly once a week. Glancing over the received dates in column 2 of Table III will reveal the reason why the reports were not forthcoming regularly from Ottawa as proposed in Report No. 1.
- (f) Sheets should be time annotated as soon as they are dry. Some sheets received were incorrectly annotated for several days in succession indicating that they had been written up in a group after some days.
- (g) The initials of the operator (or operators) responsible for each sheet should be on that sheet. See the final column at extreme right of Table III.
- (h) All adjustments of the chronometer should be recorded in notes on the seismograms. These should be sufficient to enable the chronometer corrections to be determined for the entire record time. If time comparisons were plotted regularly by the operator on a large scale graph they would tend to be more accurate and any changes in rate would show up at a time when the operator might be able to assign the reason.
- (i) All care should be taken to make sure that notice is sent to Ottawa at least a month before the stock of seismograph paper will need replenishing and at least two weeks before new developer or fixer will be needed.
- (j) It should be borne in mind that any sheet being developed may contain important data which will require

copying too for use in a report. There is no reason, in general, for finger marks (F) or stain (S) entries in the report. When the fixer or developer is low in quantity or worn out it should be replaced with fresh.

NOTE: Since the data of Table III were mimeographed, the record for August 11-12 has been received. It was not charged as lost time in Table I. The sheet has been given the number 44A of Series III. It began operation at 11-34 a.m. on the 11th and ceased at 10-41 a.m. on the 12th. No time correction was made. One bump was registered at 9-18-20 p.m. on the 11th. It was not located in the mine. It is included in the tabulation of Section 4. Except for this, the record is quiescent.

Dominion Observatory  
Ottawa, Canada,  
February 11, 1941.

Ernest A. Hodgson.

1.0' 5' 30" 10' 20' 30' 40' 50' 60' 70' 80' 90' 100'

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

### TABLE I

### Lost Time Tabulation

Category	Time (min)	Frequency	Total Time (min)
1. Absence	10	1	10
2. Delay	5	2	10
3. Break	15	1	15
4. Rest	10	1	10
5. Lunch	30	1	30
6. Travel	5	1	5
7. Waiting	10	1	10
8. Unplanned	15	1	15
9. Other	10	1	10
10. Total			120

T A B L E 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 Adjustments made at record changing time.
- b Light inadvertently turned out.
- c Sensitivity dial inadvertently set at zero.
- d Record destroyed in development.
- e Chronometer signals failed.
- f Batteries ran down.
- g Clutch on lateral drive left off.
- h Clock drum stopped.
- i Experimenting with equipment.
- j Power supply at mine changed to new system.
- k Ink supply failed (mine seismograph on surface).
- m No record received at Ottawa -- No explanation on file.
- n Pen balance out. Pen rode off paper for some time.
- p Record over-exposed to extent preventing burst record.
- q Severe electrical storm. Power off repeatedly.
- r Seismograph being demonstrated to visitor.
- s Overlap on adjacent small sheets lost in crack.
- t Chronometer ran down for lack of winding.
- u Record not changed in time -- over-run.
- v Light spot too weak to record.

TOTAL LOST TIME

PERCENTAGE LOST TIME

33509 min.

6.14 per cent

i.e. 23<sup>d</sup>06<sup>h</sup>29<sup>m</sup>

	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
1		4	2	3	8	3	2	3	3	2	833g	1	6 566m
2		185bf	2	4	2	2	3	0	13	2	668g	1	1 293ms
3		5	2	6	4	3	2	2	150a	1	1	20a	1 45s
4		644g	14	5	4	1032h	2	1	2	3	2	2	7 39s
5		791g	2	4	5	3	2	0	4	3	1	1	1 133ms
6		6	5	5	3	3	2	0	2	3	1	435g	1
7		5	8	3	3	1	2	162n	2	4	20a	2	1044g
8		6	2	2	410f	7	3	2	5	1	5	2	1
9		13	2		780f	5	3	2	1		31a	2	1
10		5	1		327ah	4	1	2	1	2	2	0	1
11		658g	3	7	744h	4	716k	?	3	2	3	1	1
12		791g	3		1217h	3	922k	3	1	2	2	1	1
13		8	6	4	3	1	2	90h	2	5	2	1	2
14		5	2	3	4	0	2	2	31a	34a	2	1	1
15		6	3	5	3	1	2	1	16	4	3	1	0
16		5	3	2	3	2	3	1	4	2	2	88u	11u
17		4	2	3	5	3	2	96n	1	2	2	1	1
18		3	5	4		4	2	2	1	2	2	1	1
19	7	44a	6		52a	784c	4	1	8	1	2	1	1
20	4825abc	5	7	2	3		392u	6	671c	1	2	2	1
21	8	7	4	2	3	3		43k	1410c	13	1	0	3
22		765d	6	4	3	2		62a	577v	1	26a	2	1
23		671d	3	3	3	2	1		1213v	1	3	2	0
24	6	6	3	2	4	1	2		782p	2	2	2	2
25		646e	547h	8	4	3	2		4 137q	1	3	2	1
26		721e	8	4	4	223i	415m	1	1 617h	1	39a	18	2
27	14	5	5	3	1	1396m	2		505h	1	1	38u	7 76m
28	6	2	6	3	2	3 295k	3	1	191h	1	878g	2	5
29	4	10	6		239h	2	2	3	1	1	487g	2	24
30	7	1356bf		3	2	2	2	2	1	1	11r	2	12 107m
31	6	3			44a	414j	0	2	1		11		1
T	3734	5108	119	3902	2174	5221	512	6150	274	1574	1623	1842	1276
P	20.7	11.4	0.3	8.7	5.0	11.7	1.2	13.8	0.6	3.6	3.6	4.3	2.9



### Adjusted Chronometer Corrections

Dec.	19	+109.9	A	Feb.	20	-115.0	C	Apr.	23	+	24.2	B
"	20	106.0	A	"	21	118.2	C	"	24		<u>21.7</u>	B
"	21	102.0	A	"	22	121.3	C	"	25		<u>19.4</u>	B
"	22	98.2	A	"	23	124.5	C	"	26		17.2	B
"	23	94.3	A	"	24	127.8	C	"	27		15.1	B
"	24	90.4	A	"	25	131.2	C	"	28		13.0	B
"	25	86.5	A	"	26	134.5	C	"	29		10.8	B
"	26	82.5	B	"	27	137.8	C	"	30		8.9	B
"	27	78.6	B	"	28	141.1	C	May	1		7.0	B
"	28	74.8	A	"	29	144.5	C	"	2		?	
"	29	70.8	A	Mar.	1	147.8	C	"	3		1.9	B
"	30	66.9	A	"	2	151.0	C	"	4	-	1.2	B
"	31	63.4	A	"	3	154.4	C	"	5		4.3	B
Jan.	1	59.7	A	"	4	157.6	C	"	6		7.5	B
"	2	56.1	B	"	5	161.1	C	"	7		10.4	B
"	3	52.3	B	"	6	164.3	C	"	8		13.4	B
"	4	48.6	B	"	7	167.7	C	"	9		16.5	B
"	5	44.9	B	"	8	171.2	C	"	10		19.5	B
"	6	41.1	B	"	9	174.6	C	"	11		22.6	B
"	7	37.5	B	"	10	178.1	C	"	12		25.7	A
"	8	33.8	B	"	11	181.6	C	"	13		28.7	A
"	9	30.1	A	"	12	?		"	14		31.5	A
"	10	26.5	A	"	13	+171.5	B	"	15		34.4	A
"	11	23.5	A	"	14	167.6	B	"	16		37.2	A
"	12	20.4	A	"	15	163.7	B	"	17		40.0	A
"	13	17.3	A	"	16	159.9	B	"	18		43.1	A
"	14	14.0	A	"	17	155.8	B	"	19		46.2	A
"	15	10.7	A	"	18	151.5	B	"	20		49.3	A
"	16	7.2	A	"	19	147.5	B	"	21		52.4	A
"	17	+ 3.5	A	"	20	143.3	B	"	22		55.5	A
"	18	- 0.2	B	"	21	139.2	B	"	23		58.7	A
"	19	4.3	B	"	22	135.0	B	"	24		<u>62.0</u>	A
"	20	8.2	B	"	23	130.5	B	"	25	+	<u>10.6</u>	A
"	21	12.2	B	"	24	126.1	B	"	26		11.6	A
"	22	16.0	B	"	25	121.5	B	"	27		<u>12.6</u>	A
"	23	19.9	B	"	26	117.0	B	"	28		<u>14.0</u>	A
"	24	23.8	B	"	27	112.5	B	"	29		15.4	A
"	25	27.7	A	"	28	109.2	B	"	30		16.8	A
"	26	31.5	A	"	29	105.3	B	"	31		18.2	A
"	27	35.3	A	"	30	101.5	B	Jun.	1		19.6	A
"	28	38.9	A	"	31	97.6	B	"	2		21.0	A
"	29	42.4	A	Apr.	1	93.7	B	"	3		22.5	C
"	30	45.7	A	"	2	89.9	B	"	4		24.0	C
"	31	49.2	A	"	3	85.9	B	"	5		25.5	C
Feb.	1	52.5	A	"	4	82.0	B	"	6		26.8	C
"	2	55.8	A	"	5	78.2	B	"	7		28.0	C
"	3	59.2	A	"	6	74.1	B	"	8		29.3	C
"	4	62.5	A	"	7	70.1	B	"	9		30.6	C
"	5	65.8	B	"	8	66.6	C	"	10		32.0	C
"	6	69.1	B	"	9	63.1	C	"	11		33.2	C
"	7	72.3	B	"	10	59.6	C	"	12		34.4	C
"	8	75.5	B	"	11	56.1	C	"	13		35.7	C
"	9	78.8	B	"	12	52.6	C	"	14		36.5	C
"	10	82.0	B	"	13	49.2	C	"	15		37.5	C
"	11	85.4	B	"	14	45.5	C	"	16		38.4	C
"	12	88.6	B	"	15	<u>43.2</u>	B	"	17		39.3	C
"	13	92.0	B	"	16	41.1	B	"	18		40.2	C
"	14	95.5	B	"	17	39.0	B	"	19		41.1	C
"	15	98.7	B	"	18	37.0	B	"	20		42.1	C
"	16	102.0	B	"	19	34.4	B	"	21		43.1	B
"	17	105.4	B	"	20	32.0	B	"	22		44.1	B
"	18	108.7	B	"	21	29.4	B	"	23		45.0	B
"	19	111.7	B	"	22	27.0	B	"	24		46.0	B

### Adjusted Chronometer Corrections

Jun.	25	+	47.0	B	Aug.	28	+	77.7	A	Oct.	31	+	13.6	A
"	26		47.9	B	"	29		<u>79.0</u>	A	Nov.	1		15.7	A
"	27		48.8	B	"	30		1.5	A	"	2		17.7	A
"	28		49.7	B	"	31		3.5	A	"	3		19.4	A
"	29		50.6	B	Sep.	1		5.5	A	"	4		21.0	A
"	30		51.5	B	"	2		7.5	A	"	5		22.4	A
Jul.	1		52.5	B	"	3		9.6	A	"	6		23.6	A
"	2		53.4	B	"	4		11.6	A	"	7		24.9	A
"	3		54.3	B	"	5		13.7	A	"	8		26.0	A
"	4		55.2	B	"	6		15.7	A	"	9		27.1	A
"	5		<u>56.1</u>	B	"	7		17.7	A	"	10		28.2	A
"	6		0.5	B	"	8		19.8	A	"	11		29.5	A
"	7		2.2	B	"	9		21.7	B	"	12		30.6	A
"	8		3.6	B	"	10		23.8	B	"	13		31.8	A
"	9		5.2	B	"	11		26.0	B	"	14		33.0	A
"	10		6.7	B	"	12		28.3	B	"	15		34.2	A
"	11		8.3	B	"	13		30.4	B	"	16		35.5	A
"	12		9.7	B	"	14		32.6	B	"	17		37.0	A
"	13		10.9	B	"	15		34.7	B	"	18		38.5	A
"	14		12.0	B	"	16		37.0	B	"	19		40.0	A
"	15		13.2	B	"	17		39.2	B	"	20		41.5	A
"	16		14.3	B	"	18		41.3	B	"	21		43.0	A
"	17		15.4	B	"	19		43.5	B	"	22		44.2	A
"	18		16.5	B	"	20		45.7	B	"	23		45.1	A
"	19		18.0	B	"	21		48.0	B	"	24		46.0	A
"	20		19.2	B	"	22		50.4	B	"	25		47.0	A
"	21		20.5	B	"	23		52.7	B	"	26		47.9	A
"	22		21.9	B	"	24		55.1	B	"	27		49.0	A
"	23		23.2	B	"	25		57.5	B	"	28		50.1	A
"	24		24.5	B	"	26		60.0	B	"	29		51.7	A
"	25		25.7	B	"	27		62.4	B	"	30		53.1	A
"	26		27.0	B	"	28		64.7	B	Dec.	1		54.5	A
"	27		28.3	B	"	29		67.3	B	"	2		56.1	A
"	28		29.6	B	"	30		69.6	B	"	3		57.6	A
"	29		31.1	A	Oct.	1		72.0	B	"	4		59.2	A
"	30		32.6	A	"	2		74.5	B	"	5		60.5	A
"	31		34.2	A	"	3		77.0	B	"	6		62.0	A
Aug.	1		35.8	A	"	4		79.5	B	"	7		62.6	A
"	2		37.5	A	"	5		81.8	B	"	8		63.6	A
"	3		39.0	A	"	6		84.3	B	"	9		64.7	A
"	4		40.6	A	"	7		86.5	B	"	10		65.9	A
"	5		42.1	A	"	8		88.7	B	"	11		67.0	A
"	6		43.7	A	"	9		90.7	B	"	12		68.1	A
"	7		44.5	A	"	10		92.7	B	"	13		69.2	A
"	8		47.3	A	"	11		94.7	B	"	14		70.4	A
"	9		49.5	A	"	12		96.7	B	"	15		71.5	A
"	10		51.3	C	"	13		99.0	A	"	16		72.7	A
"	11		53.0	C	"	14		101.0	A	"	17		74.7	A
"	12		54.8	C	"	15		103.0	A	"	18		76.6	A
"	13		56.5	C	"	16		105.0	A	"	19		78.4	A
"	14		58.4	C	"	17		107.0	A	"	20		80.2	A
"	15		60.2	C	"	18		<u>108.6</u>	A	"	21		82.0	A
"	16		62.0	C	"	19		110.1	A	"	22		<u>83.8</u>	A
"	17		63.7	C	"	20		111.6	A	"	23		1.4	A
"	18		65.5	C	"	21		113.2	A	"	24		2.6	A
"	19		67.2	B	"	22		104.6	A	"	25		?	A
"	20		68.2	A	"	23	+	<u>106.4</u>	A	"	26		26.0	A
"	21		69.5	A	"	24	-	0.8	A	"	27		26.8	A
"	22		70.5	A	"	25	+	1.2	A	"	28		27.5	A
"	23		71.8	A	"	26		3.3	A	"	29		28.5	A
"	24		73.0	A	"	27		5.4	A	"	30		29.3	A
"	25		74.1	A	"	28		7.5	A	"	31		30.1	A
"	26		75.3	A	"	29		9.5	A	Jan.	1		31.0	A
"	27		76.5	A	"	30		11.5	A	"	2		31.7	A



KIRKLAND LAKE SEISMOLOGICAL STATION  
 Explanation of Symbols  
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- (1) Dates are recorded as Day:Month  
 e.g. 19:12 indicates December 15.
- (2) Times are recorded with systems separating hours, minutes and seconds, e.g. 4:11-41.3. In general, times given 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

0 to 3 with the following significations:  
 3 = excellent; 2 = fair; 1 = doubtful;  
 0 = lacking altogether or quite useless.

Brackets about the number denoting the value of the correction in seconds. The source of the correction was a clock, chronometer, or not, as uncorrected or corrected. The number in this case indicates the degree of agreement of the particular value with the clock or chronometer.

T A B L E    I I I

Detailed Tabulation of Seismograms

- (4) Time correction +/- means clock slow / fast.
- (5) Amount of time correction is given in minutes 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, 1:15 means that the clock was found to be 15 min. 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/BS = Blasting at York Hughes / Wright Margreaves.
  - C = Charging equipment resonance interference.
  - F = Finger marks on record.
  - S = Stain from developer on record.
  - h/B- = Rate of driving clock accelerated / retarded.
  - G = Gase interference from gasometer (indicated by symbol).
  - l/L/Ly = Light intensity too strong / too weak / or variable.
  - a, b, c, etc. = Index letters to indicate on same report sheet.
- Brackets on any letter, e.g. (B), denote in general that the amplitude recorded is relatively small. However, see also (7) data.
- M/V/I, etc. at the end of the remarks line indicate the operator whose initials appear at the record as Matherly / Brown / Hargrave, etc.

KIRKLAND LAKE SEISMOGRAM RECORD

Explanation of Symbols

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- (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  
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<sup>S</sup>: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 Tech 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.

KIRKLAND LAKE SEISMOGRAM RECORD

December, 1939

No.	Rec'd	On		Off		Time Correction		Bursts	Quakes	Remarks	
		Time	Date	Time	Date	Value	Amount				
1	30:12	11-35 a.m.	19:12	4-16 p.m.	19:12	3	+110. :12	1	-	B,a.	<u>H</u>
2	"	5-00 p.m.	19:12	9-45 p.m.	19:12	0	-	-	-	G,R+.	<u>H</u>
3	"	9-52 p.m.	19:12	9-42 a.m.	20:12	3	+108. :22	-	-	B,F. Corr. = 106.5:2	<u>H</u>
4	"	9-46 a.m.	20:12	3-31 p.m.	20:12	3	+106. :13	-	-	B,F,S,C.	<u>H</u>
5	"	4-21 p.m.	20:12	9-02 p.m.	20:12	0	-	-	-	F. Light off 5-12 to 5-25 -- no record.	<u>H</u>
6	"	9-45 p.m.	20:12	9-44 a.m.	21:12	3	+104.5 :22	-	-	(F), Is,R-. Sensitivity set at 0 by mistake.	<u>H</u>
7	"	9-52 a.m.	21:12	11-15 a.m.	22:12	0	-	-	-	Iv,B.	<u>H</u> , <u>B</u>
8	"	-	22:12	-	23:12	-	-	-	-	Sheet destroyed. Spoiled in developing.	<u>?</u>
9	"	11-11 a.m.	23:12	1-03 p.m.	24:12	2	+ 90. :13	-	-	B,b.	<u>R</u>
10	"	1-09 p.m.	24:12	1-14 p.m.	25:12	0	-	-	-	S. Could not get NAA signals at noon.	<u>R</u>
11	"	?	25:12	?	26:12	0	-	-	-	Iw. Chronometer connection broken. No time marks.	<u>?</u>
12	"	12-01 p.m.	26:12	12-35 p.m.	27:12	2	+ 81.5 :14	-	-	Iv. CHU signal by key. No trace Turkey quake.	<u>B</u>
13	1940 5:1	12-49 p.m.	27:12	12-40 p.m.	28:12	1	+ 78. :13	3?	-	B.	<u>B</u>
14	"	12-46 p.m.	28:12	12-22 p.m.	29:12	1	+ 74.5 :13	-	-	G?,C,(Iv).	<u>B</u>
15	"	12-26 p.m.	29:12	11-38 a.m.	30:12	1	+ 70.5 :13	-	-	G,B,(F),(C),Is.	<u>?</u>
16	"	11-45 a.m.	30:12	12-23 p.m.	31:12	1	+ 67. :13	1	-	B,(C). Good line intensity. c.	<u>?</u>
17	"	12-29 p.m.	31:12	12-40 p.m.	1:1	1	+ 63. :13	1?	-	C.	<u>R</u>

a Well-marked burst, felt generally in Kirkland Lake, recorded at 12-53-14 a.m., ~~Jan.~~<sup>Dec.</sup> 19.

b Two sharp offsets 10-16 to 10-18 p.m., Dec. 23.

c Small burst, reported by mine captain and registered at 9-41-51 p.m., Dec. 30.

KIRKLAND LAKE SEISMOGRAM RECORD  
January, 1940

No.	Rec'd	On		Off		Time Correction		Bursts	Quakes	Remarks		
		Time	Date	Time	Date	Value	Amount					
18	5:1	12-44 p.m.	1:1	11 a.m. ca.	2:1	3	+ 59.5	:13	1?	-	Batteries ran down. Record fades after 11 a.m.	R
19	13:1	1-12 p.m.	2:1	1-02 p.m.	3:1	2	+ 51.5	: <u>13</u>	1?	-	S, (Iw), B, BT. Light out 3-02 to 3-55 p.m., Jan. 2.	B
20	"	1-07 p.m.	3:1	1-16 p.m.	4:1	3	+ 48.	: <u>13</u>	2?	-	(Iw), B, BT.	B
21	"	1-22 p.m.	4:1	1-05 p.m.	5:1	0	-		-	-	Clutch not completely engaged. No record.	B
22	"	1-11 p.m.	5:1	11-25 a.m.	6:1	1	+ 44.5	:14	2?	-	B, (G), Iw.	B
23	"	11-31 a.m.	6:1	1-02 p.m.	7:1	3	+ 37.	: <u>13</u>	1+?	-	B, C, (G), a. Very good light-spot intensity. Copied.	?
24	"	1-07 p.m.	7:1	1-03 p.m.	8:1	3	+ 33.	: <u>13</u>	1?	-	Is, C, B, G. Good sharp blasting record.	?
25	"	1-09 p.m.	8:1	1-03 p.m.	9:1	3	+ 30.	: <u>13</u>	2?	-	(Is), B, BT. Very nice rate on clock drive.	B
26	"	1-16 p.m.	9:1	1-01 p.m.	10:1	2	+ 26.5	: <u>13</u>	4?	-	B, G, BT.	B
27	23:1	1-06 p.m.	10:1	1-02 p.m.	11:1	3	+ 23.5	: <u>13</u>	2+	-	B. Effective light-spot intensity.	?
28	"	1-06 p.m.	11:1	1-05 p.m.	12:1	-	-		-	-	No record. Clutch out. Breaking in new man.	B
29	"	1-11 p.m.	12:1	12-39 p.m.	13:1	1	+ 20.	:14	1?	-	G, B, C. CHU time signal.	B
30	"	12-47 p.m.	13:1	12-32 p.m.	14:1	3	+ 17.	:13	-	-	B, G, Is (corrected after 1-47 p.m.), b.	A+R
31	"	12-37 p.m.	14:1	1-02 p.m.	15:1	2	+ 10.5	: <u>13</u>	1?	-	Iw, (C). Second of two time comparisons used.	B
32	"	1-08 p.m.	15:1	1-04 p.m.	16:1	3	+ 7.	: <u>13</u>	1?	-	S, Is, B, (G). Well-marked blasting. Shaft No. 4.	B
33	"	1-09 p.m.	16:1	1-09 p.m.	17:1	3	+ 3.5	: <u>13</u>	1?	-	C, B, G. Bubble blank due to developing (small).	B
34	"	1-13 p.m.	17:1	1-04 p.m.	18:1	3	0	: <u>13</u>	1+2?	-	(F), B, c. Change to 12-volt charger.	B
a	Small, but well-marked, burst at 5-09-53.5 a.m., Jan. 7.											
b	Dance and card party in the gymnasium on evening of Jan. 13.											
c	Fairly well-marked burst at 10-17-43 p.m., Jan. 17. Was "not located in the mine".											

KIRKLAND LAKE SEISMOGRAM RECORD  
January, 1940

No.	Rec'd	On		Off		Time Correction		Bursts	Quakes	Remarks	
		Time	Date	Time	Date	Value	Amount				
35	23:1	1-07 p.m.	18:1	1-06 p.m.	19:1	0	-	1+2?	0	G, (C), B, (G), a. Time signal useless.	<u>?</u>
36	1:2	1-12 p.m.	19:1	11-18 a.m.	20:1	2	- 9.0 :11	1?	0	(B), S, Is, b. CHU by key.	<u>B</u>
37	"	11-23 a.m.	20:1	1-04 p.m.	21:1	3	-12.0 :13	3?	0	(B), Is. Dance in gymnasium disturbs very little.	<u>B</u>
38	"	1-11 p.m.	21:1	1-03 p.m.	22:1	3	-16.5 :13	1?	0	Is, G, b.	<u>B</u>
39	"	1-09 p.m.	22:1	1-05 p.m.	23:1	1	-20.0 :13	1	0	B, Iv, b, c.	<u>B</u>
40	"	1-08 p.m.	23:1	1-03 p.m.	24:1	0	-	2?	0	B, (G), b.	<u>B</u>
41	"	1-09 p.m.	24:1	4-03 a.m.	25:1	0	-	5?	0	B, (C). Clockwork of recorder stopped at 4-03 a.m.	<u>B</u>
42	"	1-10 p.m.	25:1	1-03 p.m.	26:1	3	-31.5 :13	1?	0	B, d. Power supply very irregular.	<u>B</u>
43	"	1-11 p.m.	26:1	11-33 a.m.	27:1	2	-35.0 :11	7?	0	B, Iv.	<u>B</u>
44	10:2	11-38 a.m.	27:1	12-49 p.m.	28:1	1	-35.5 :12	6?	0	B, Is, e. CHU key. Blasting well recorded.	<u>B</u>
45	"	12-51 p.m.	28:1	1-14 p.m.	29:1	1	-38.5 :13	2?	0	(G). Intensity of line fading throughout the day.	<u>Mc</u>
46	"	1-24 p.m.	29:1	-	30:1	0	-	-	-	Line faded out after about two hours. No record.	<u>Mc</u>
47	"	1-43 p.m.	30:1	1-04 p.m.	31:1	3	-49.5 :13	3?	0	B. Some interruptions due to electrician working.	<u>Mc</u>
48	"	1-07 p.m.	31:1	1-05 p.m.	1:2	3	-52.5 :13	5?	0	Is, B, G. Two hours at end Iw. Electrician working.	<u>Mc</u>
a	Rock burst lasting about 30 sec. began 10-12-31 a.m. Jan. 19.									Occurred in Teck Hughes abandoned workings.	
b	Light intensity changes abruptly in value a number of places.									Due to cutting off of motor generator set.	
c	Rock burst with first shot of blast at 3-11-51 p.m. Jan. 22.										
d	Time comparison using CHU and key at 14 <sup>h</sup> Jan. 25. Correction									-28 <sup>s</sup> 0.	
e	Intensity corrected to a good normal line at 3-24 a.m. Jan. 28.										

KIRKLAND LAKE SEISMOGRAM RECORD

February, 1940

No.	Rec'd	On		Off		Time Correction		Bursts	Quakes	Remarks	
		Time	Date	Time	Date	Value	Amount				
49	10:2	1-07 p.m.	1-2	1-05 p.m.	2-2	2	-56. :13	2?	0	Is,B,C,G.	<u>?</u>
50	"	1-07 p.m.	2-2	11-11 a.m.	3-2	0	-	3?	0	Is,B,C,G,(S). Strong blasting record.	<u>?</u>
51	"	11-13 a.m.	3-2	1-04 p.m.	4-2	2	-61.5 :13	3?	0	B,C,G,a.	<u>B</u>
52	"	1-18 p.m.	4-2	1-05 p.m.	5-2	2	-65.5 :13	?	0	G,b,	<u>B</u>
53	"	1-07 p.m.	5-2	1-04 p.m.	6-2	1	-69. :13	5?	0	C,BT,c.	<u>B</u>
54	19:2	1-09 p.m.	6-2	1-04 p.m.	7-2	1	-72.5 :13	2?	0	(G),Is,C. Record torn and repaired.	<u>B</u>
55	"	1-12 p.m.	7-2	1-07 p.m.	8-2	3	-76. :13	2?	0	S,(F),B,(C). Very dirty sheet.	<u>Mc</u>
56	"	1-09 p.m.	8-2	1-04 p.m.	9-2	3	-79. :13	1+2?	0	(F),(S),(G),B,d.	<u>Mc</u>
57	"	1-06 p.m.	9-2	11-08 a.m.	10-2	1	-82. :11	1?	0	(S),C,B. Marked regular generator interference. CHU.	<u>Mc</u>
58	"	11-09 a.m.	10-2	1-07 p.m.	11-2	2	-85.5 :13	2?	0	(G),S,(F),B,C. Heavy blast recorded.	<u>Mc</u>
59	"	1-10 p.m.	11-2	1-06 p.m.	12-2	1	-89. :13	1?	0	B,(G). Interference continues but is less. CHU.	<u>Mc</u>
60	"	1-09 p.m.	12-2	1-04 p.m.	13-2	1	-92. :13	?	0	Iw,B. Line fading markedly. CHU.	<u>Mc</u>
61	"	1-10 p.m.	13-2	1-07 p.m.	14-2	2	-95.5 :13	1?	0	(S),Iw,C.	<u>Mc</u>
62	"	1-09 p.m.	14-2	1-04 p.m.	15-2	1	-99.5 :13	1+1?	0	Iw,B,e.	<u>Mc</u>

a A very nice recording line but charger interference of regular pattern clearly shows.

b Light strain bursts noted in 3414 drift between 8 and 9 a.m. not recorded.

c Light strain burst in 3413 drift at 8 p.m. not recorded Blasting in No. 4 shaft 4-45 p.m. and 8 a.m. not recorded.

d Bump in 2504W stope at 12-17-05 a.m. Feb. 9. Other "cracks" in 3414W drift from 8 to 10.30 a.m. did not record.

e Burst, 9-05-40 p.m., Feb. 14, 3309E stope, 3209 drift. Recorded 30 sec. Light burst, 4301W-5 stope, 2-05 p.m.

KIRKLAND LAKE SEISMOGRAM RECORD  
February, 1940

No.	Rec'd	On		Off		Time Correction		Bursts	Quakes	Remarks	
		Time	Date	Time	Date	Value	Amount				
63	28:2	1-07 p.m.	15:2	1-04 p.m.	16:2	3	-103. :13	1?	0	B,S,G,C.	<u>Mc</u>
64	"	1-07 p.m.	16:2	10-42 a.m.	17:2	2	-105.5 :10	?	0	B,C,a.	<u>Mc</u>
65	"	10-44 a.m.	17:2	1-03 p.m.	18:2	2	-108.5 :13	?	0	B,C,a.b.	<u>N</u>
66	"	1-08 p.m.	18:2	1-07 p.m.	19:2	2	-111.5 :13	?	0	C,(S),(F),a.	<u>?</u>
67	"	1-09 p.m.	19:2	1-05 p.m.	20:2	0	-	?	0	Iw,C,(S),a,c. Cracking 4202E. Light burst 4201W5. g.	<u>B</u>
68	"	1-12 p.m.	20:2	1-06 p.m.	21:2	2	-117.5 :13	1+	0	Iw,C,a,d.	<u>W</u>
69	"	1-10 p.m.	21:2	1-06 p.m.	22:2	1	-120.5 :13	?	0	Iw,C,a.	<u>W</u>
70	"	1-10 p.m.	22:2	1-05 p.m.	23:2	3	-125. :13	0	0	Iw,C,(S),c. Bump reported but not recorded.	<u>B</u>
71	"	1-08 p.m.	23:2	10-43 a.m.	24:2	0	-	1	0	Iw,C,F,S,a,e.	<u>B</u>
72	"	10-46 a.m.	24:2	12-51 p.m.	25:2	0	-	1	0	Iw,C,b,f.	<u>B</u>
73	8:3	12-59 p.m.	25:2	1-06 p.m.	26:2	1	-134.5 :13	?	0	Iw,C,(F),a. Developer reported as weak.	<u>B</u>
74	"	1-10 p.m.	26:2	1-06 p.m.	27:2	1	-138.5 :13	?	0	Iw,S,F,C,a.	<u>W</u>
75	"	1-11 p.m.	27:2	1-35 p.m.	28:2	1	-141.5 :13	0	0	Iw,(F),C,a. Record fading (not fixed).	<u>W</u>
76	"	1-41 p.m.	28:2	1-06 p.m.	29:2	1	-144. :13	1	0	Iw,C,a. Small strain burst 3025 stope.	<u>W</u>
77	"	1-12 p.m.	29:2	1-07 p.m.	1:3	1	-147. :13	1?	0	Iw,(S),(F),a.	<u>B</u>

a Registration of blasting becoming markedly weaker. g Not recorded.  
b Dance and card party in gymnasium. Hardly shows any traces.  
c Badminton, blasting, and known bursts show no record. Installation seems to have lost its sensitivity.  
d Heavy rockburst between 4075E and 4325E at 3-15-35.5 p.m. Feb. 20, lasting about 30 seconds.  
e Burst in 4301E at 2-47-24 a.m. Feb. 24, lasting about 4 seconds.  
f Pillar blast at Teck Hughes at 6-30 a.m. Feb. 25. Registered about 10 sec.

KIRKLAND LAKE SEISMOGRAM RECORD

March, 1940

No.	Rec'd	On		Off		Time Correction		Bursts	Quakes	Remarks
		Time	Date	Time	Date	Value	Amount			
78	18:2 <sup>3</sup>	1-10 p.m.	1:3	9-39 a.m.	2:3	1	-151. :10	2	0	Iw,C,a. Two small bursts felt on surface not located. <u>B</u>
79	"	9-43 a.m.	2:3	1-03 p.m.	3:3	0	-	1?	0	Iw,C,(S),a. Line too weak to read time signal. <u>W</u>
80	"	1-09 p.m.	3:3	1-05 p.m.	4:3	1	-157. :13	0	0	Iw, to 10-50 a.m. Mar. 4 then Is. Sheet fogged. (S). <u>N</u>
81	19:3	1-10 p.m.	4:3	1-06 p.m.	5:3	1	-161.5 :13	2?	0	(S),B,BT,b. <u>W</u>
82	"	1-10 p.m.	5:3	1-05 p.m.	6:3	2	-164. :13	0	0	B,b. Nice line, but very low sensitivity. <u>W</u>
83	"	1-10 p.m.	6:3	1-06 p.m.	7:3	3	-168. :13	0	0	Iw,(C),(B). <u>W</u>
84	"	1-09 p.m.	7:3	1-08 p.m.	8:3	3	-171. :13	1?	0	(Is),(C). Spot adjusted 9-37 a.m. on 8th to Is. c. <u>M</u>
85	"	1-10 p.m.	8:3	?	9:3	0	-	0	0	Line faded out after about 4 hours. <u>H</u>
86	"	1-00 p.m.	9:3	1-08 p.m.	10:3	1	-178. :13	1+2?	0	B. Line restored to optimum. d. <u>H+G</u>
87	"	1-43 p.m.	10:3	7-08 p.m.	10:3	0	-	0	0	Iw. Clock stopped at 7-08 p.m. on 10th. <u>H</u>
88	"	12-24 p.m.	11:3	5-01 p.m.	11:3	0	-	0	0	(C). Time signal no good. Reception poor. <u>H+G</u>
89	"	5-08 p.m.	11:3	?	12:3	0	-	1?	0	(Is). Clock stopped twice. Wound only on one side. <u>H</u>
90	"	9-16 p.m.	12:3	6-26 a.m.	13:3	0	-	0	0	Is,B,BT,e. Timing circuit put on dry cell. <u>H+G</u>
91	"	6-30 a.m.	13:3	4-24 p.m.	13:3	3	+171. : 4	2	0	Is,C,B,f. RESET CHRONOMETER. <u>G</u>
92	"	4-28 p.m.	13:3	5-07 p.m.	14:3	1	+167. : 5	3?	0	Is,C,B,G. <u>G</u>

- a Line very faint and heavy interference by generator. Blasting hardly discernible. Sheets fading.
- b Good black line restored; Interference gone; Fixing adequate again; but amplitude of blasting record small.
- c Hodgson and Gibbs arrived in Kirkland Lake for preliminary experiments in the mine.
- d Small bump 4402E(?) at 5-15-47 a.m. March 10. Shook loose in drift. Location of burst not certain.
- e Rewired timing circuit. Diagram on back sheet 90. Removed friction from coil of seismometer. Blasting records now.
- f Strain bursts in 3414W between 1 and 2 p.m. March 13. Both well recorded.



## KIRKLAND LAKE SEISMOGRAM RECORD

March, 1940

No.	Rec'd	On		Off		Time Correction		Bursts	Quakes	Remarks
		Time	Date	Time	Date	Value	Amount			
93	11:4	5-10 p.m.	14:3	5-41 p.m.	15:3	1	+163. :18	2?	0	Is,B,BT. Blasting very well recorded. <u>G</u>
94	"	5-46 p.m.	15:3	5-09 p.m.	16:3	2	+159. :17	7?	0	Is,B,BT. Blasting very well recorded. <u>H+G</u>
95	"	5-11 p.m.	16:3	5-09 p.m.	17:3	3	+155.5 :17	1?	0	Iv,B,BT. <u>H+G</u>
96	"	5-12 p.m.	17:3	5-12 p.m.	18:3	3	+150.5 :17	0	0	Is,B. Bump in 4325 X-cut not registered. <u>G</u>
97	"	5-16 p.m.	18:3	5-32 p.m.	19:3	0	-	0	0	Is,B,BT,G. Light burst in 3025W-8 stope not recorded. <u>G</u>
98	"	6-24 p.m.	19:3	5-04 p.m.	20:3	0	-	1	0	B,BT,a. Burst not reported. Good record. <u>G</u>
99	"	5-06 p.m.	20:3	5-12 p.m.	21:3	3	+142. :18	1	0	Is,C,b. Overdeveloped purposely. Badly stained. <u>G</u>
100	18:4	5-14 p.m.	21:3	5-01 p.m.	22:3	3	+134.5 :17	1?	0	B,BT. <u>G</u>
101	"	5-04 p.m.	22:3	5-02 p.m.	23:3	3	+129.5 :17	2?	0	B,BT. Small burst recorded, 2701W drift? <u>G</u>
102	"	5-05 p.m.	23:3	5-20 p.m.	24:3	2	+125. :17	2?	0	B,BT,Iv. Blasting well recorded. <u>G</u>
103	"	5-22 p.m.	24:3	5-04 p.m.	25:3	3	+120.5 :17	3	0	c. Generator brushes changed. Easter Sunday. <u>G</u>
104	"	5-08 p.m.	25:3	5-01 p.m.	26:3	3	+116. :17	1	0	Iw,(C),(G). Small snap (in 2718 X-cut?) recorded. <u>G</u>
105	"	5-05 p.m.	26:3	5-08 p.m.	27:3	3	+112. :17	0	0	Iv,BT,B. Clock rate sensibly diminishes. <u>G</u>
106	"	5-11 p.m.	27:3	5-06 p.m.	28:3	3	+108.5 :17	3	0	C,S,B,BT,(G),d. Development purposely forced. <u>G</u>
107	"	5-09 p.m.	28:3	10-11 a.m.	29:2	2	+106. :10	1?	0	B,BT. Clockwork drive stopped 10-11 a.m. on 29th. <u>G</u>
108	"	2-10 p.m.	29:3	4-01 p.m.	30:3	3	+100.5 :16	1+2?	0	Iv. Sharp burst 2-12 p.m. on 30th not located. <u>G</u>
109	"	4-03 p.m.	30:3	1-02 p.m.	31:3	3	+ 97. :13	1	0	Iv,C,F,B,BT. Sharp burst 9-45 p.m. 31st not located. <u>G</u>
a	Line proper intensity but shows the irregularity of the pendulum drive. Lens removed from light path.									
b	Clock rate seems to have become decidedly more rapid.									
c	Burst in 2901W-6 to 10 at 7-36-55; another (location not known) at 7-59-20; a third probably in 3025W-8 at 11-44. All p.m. on 24th.									
d	Heavy crack in 2702E-1 at 8-47 p.m. on 26th registered. Another in 4301W-4 at 12-15 a.m. on 27th failed to register.									

KIRKLAND LAKE SEISMOGRAM RECORD

April, 1940

No S2	Rec'd	On		Off		Time Correction		Bursts	Quakes	Remarks	
		Time	Date	Time	Date	Value	Amount				
19	19:4	1-46 p.m.	31:3	1-01 p.m.	1:4	-	-	2?	0	a,b,BT. Amplification apparently low.	<u>G</u>
20	"	1-09 p.m.	1:4	3-04 p.m.	2:4	-	-	0	0	B,BT. Sheets well annotated with correlations	<u>G</u>
21	"	3-06 p.m.	2:4	1-11 p.m.	3:4	-	-	?	0	B,BT.	<u>?</u>
22	"	1-15 p.m.	3:4	1-14 p.m.	4:4	-	-	1	0	B,BT,G. Light burst in 3802E7-2 stope.	<u>?</u>
23	"	1-18 p.m.	4:4	1-01 p.m.	5:4	(2) + 77.5	: <u>13</u>	0	0	B,BT,G,b.	<u>?</u>
24	"	1-06 p.m.	5:4	3-45 p.m.	6:4	(2) + 73.5	: <u>15</u>	1	0	B,BT. Heavy crack in 3025W-8 at 12-43 a.m. on 6th.	<u>N</u>
25	"	3-48 p.m.	6:4	4-01 p.m.	7:4	(2) + 69.5	: <u>16</u>	0	0	B,BT,G.	<u>?</u>
26	"	4-04 p.m.	7:4	10-01 a.m.	8:4	(2) + 67.	: <u>10</u>	0	0	Very quiet Sunday record.	<u>?</u>
27	"	10-08 a.m.	8:4	10-01 a.m.	9:4	(0) + 62.	: <u>10</u>	4	0	B,BT,G,c. Sheets well correlated.	<u>W+B</u>
28	"	10-06 a.m.	9:4	10-01 a.m.	10:4	(2) + 60.	: <u>10</u>	1+?	0	B,BT,G. Burst in 3025 at midnight. Good record.	<u>B</u>
29	"	10-05 a.m.	10:4	10:01 a.m.	11:4	(2) + 56.	: <u>10</u>	?	0	B,BT,G.	<u>?</u>
30	"	10-05 a.m.	11:4	1-02 p.m.	12:4	(2) + 53.	: <u>13</u>	?	0	B,BT.	<u>?</u>
31	"	1-05 p.m.	12:4	3-01 p.m.	13:4	-	-	0	0	Record much disturbed by laboratory construction.	<u>W+B</u>
32	"	3-04 p.m.	13:4	2-01 p.m.	14:4	(0) + 47.	: <u>14</u>	?	0	Amplifier oscillating. Second half of record useless.	<u>?</u>
33	"	2-05 p.m.	14:4	1-01 p.m.	15:4	(2) + 43.	: <u>13</u>	?	0	Amplifier oscillating on low gain during whole day.	<u>?</u>
a	Nos. 1-16 of Series 2 (Mine Seismograph) were registered in the mine. No. 19 is the first of this series recorded by this instrument alone in vault.										
b	Time corrections when given for Series 2 are obtained from desk memoranda. Rate diminishes after about April 7.										
c	Three snaps in 3075-level 8 to 9-30 p.m. Apr. 9. Bump felt and registered but not located 10-13 p.m. Apr. 9.										

KIRKLAND LAKE SEISMOGRAM RECORD

April, 1940

No.	Rec'd	On		Off		Time Correction		Bursts	Quakes	Remarks	
		Time	Date	Time	Date	Value	Amount				
34	19:4	1-04 p.m.	15:4	1-01 p.m.	16:4	(2) + 41.	:13	?	0	B,BT,a. Gain set low apparently.	?
35	"	1-04 p.m.	16:4	1-01 p.m.	17:4	(2) + 39.	:13	1	0	B,b. Sharp crack on 3700 level. Registered.	N
36	9:5	1-06 p.m.	17:4	1-02 p.m.	18:4	(2) + 37.	:13	0	0	Amplifier turned down accidentally. No sensitivity.	W
37	"	1-04 p.m.	18:4	2-01 p.m.	19:4	(2) + 34.	:14	2+?	0	Oscillation, low gain, 2 reported bursts registered. c.	?
38	"	2-04 p.m.	19:4	2-01 p.m.	20:4	(2) + 31.	:14	?	0	Oscillation on low gain.	W
39	"	2-04 p.m.	20:4	3-01 p.m.	21:4	(2) + 29.	:15	0	0	Some oscillation on low gain. Quiet Sunday record.	?
40	"	3-04 p.m.	21:4	2-12 p.m.	22:4	(3) + 26.5	:14	0	0	Oscillation trouble taken over Z.E.G. Temporary repair.	G
41	"	2-15 p.m.	22:4	1-04 p.m.	23:4	(3) + 24.	:13	?	0	B,BT,G. Good record. Oscillation trouble corrected.	G
42	"	1-06 p.m.	23:4	1-47 p.m.	24:4	(3) + 21.5	:14	1	0	B,BT,G. Bump 8-45 a.m. Not located.	G
43	"	1-51 p.m.	24:4	2-05 p.m.	25:4	(3) + 19.5	:13	1+?	0	B. New fine pointed pen installed. Dry 10-05 p.m. to 10.16 a.m.	G
44	"	2-08 p.m.	25:4	5-11 p.m.	26:4	(3) + 17.	:16	1+?	0	B,BT,G,d. Oscillation.	G
45	"	6- p.m.	26:4	8-54 p.m.	26:4	-	-	0	0	Test sheet for amplifier. Tube of pen found corroded.	G
45A	"	8-54 p.m.	26:4	2-01 p.m.	27:4	(3) + 14.5	:14	1	0	e. Registered burst in 3902E dr. 10-44 a.m.	G
46	"	2-02 p.m.	27:4	4-04 p.m.	28:4	-	-	1	0	B,BT,G. Burst 4-26-36 p.m. in 3001W-10 stope.	G
47	"	4-06 p.m.	28:4	5-01 p.m.	29:4	(3) + 10.5	:17	?	0	B. Sunday record. Quiet first half. Low gain also?	G
48	"	5-03 p.m.	29:4	4-05 p.m.	30:4	(3) + 9.	:16	1	0	f. Power off 9 a.m. to 3-54-12 p.m. Changing power supply.	G
49	"	4-07 p.m.	30:4	8-00 p.m.	1:5	(3) + 6.	:20	2	0	B,BT,G,g. Normal record. Light burst 3025W dr. 12-45 a.m.	G
a	Light strain burst in 4001W-7 reported at 9 a.m. on 16th but not registered. Clock rate again diminishes.										
b	Time corrections for second series to this date are not very consistent. Values given only to nearest second.										
c	Clock rate diminishes still further. (f) Bump reported, registered, but not located 3-07 p.m. (g) Bump 2-50 p.m.										
d	Fairly heavy burst 3301W, 2401W, and 3501W dr. Felt seven miles. Registered before oscillation trouble. not located.										
e	Notes on sheet re electrical changes. Heiland geophone (No. 331) removed. Shipped to Ottawa. Replaced by second geophone.										

KIRKLAND LAKE SEISMOGRAM RECORD  
May, 1940

No.	Rec'd	On		Off		Time Correction		Bursts	Quakes	Remarks	
		Time	Date	Time	Date	Value	Amount				
50	5:9	8-04 p.m.	1:5	5-17 p.m.	2:5	(3) +	4. :17	3	0	B,BT,G. Three heavy bursts. One located in 3201W-10.	G
51	"	5-19 p.m.	2:5	8-13 p.m.	3:5	(3) +	1. :21	0	0	B,BT,G,a. Low gain? Surface blasts half mile register.	G
52	"	8-16 p.m.	3:5	12-14 a.m.	4:5	-	-	0	0	B,BT. Clock stopped 12-14 a.m. Wound on one side only.	G
53	"	5-26 p.m.	4:5	7-01 p.m.	5:5	(3) -	5. :19	0	0	B,BT. Low gain? Drive clock rate very good.	G
54	"	7-04 p.m.	5:5	4-15 p.m.	6:5	(3) -	8. :16	0	0	B. First half quiet (Sunday). Low gain?	G
55	"	4-18 p.m.	6:5	5-01 p.m.	7:5	(3) -	11. :17	?	0	B,BT. Low gain?	G
56	"	5-02 p.m.	7:5	5-42 p.m.	8:5	(3) -	14.5 :18	?	0	B,BT. Low gain?	G
57	"	5-43 p.m.	8:5	4-40 p.m.	9:5	(3) -	17. :13	?	0	B,BT. Low gain? Not much activity registered.	G
58	"	4-43 p.m.	9:5	5-23 p.m.	10:5	(3) -	20. :14	?	0	B,BT. Very good drive clock rate.	G
59	"	5-24 p.m.	10:5	12-04 p.m.	11:5	(3) -	22.5 :12	?	0	B,BT. LS blasting less pronounced than TH.	G
60	"	-	11:5	-	12:5	(0) -	27. :15	-	-	Ink supply failed. No record. Correction NG.	G
61	"	3-22 p.m.	12:5	4-50 p.m.	13:5	(3) -	29. :17	0	0	Sunday record. First half quiescent.	G
62	"	4-51 p.m.	13:5	5-36 p.m.	14:5	(3) -	31. :21	?	0	B,BT. Sheets definitely less well correlated.	G
63	"	5-36 p.m.	14:5	3-58 p.m.	15:5	(3) -	35. :16	?	0	B, BT. LS blasting poorly recorded.	G
64	"	3-59 p.m.	15:5	4-50 p.m.	16:5	(3) -	37. :10	?	0	B, BT. LS blasting poorly recorded.	G
65	"	4-52 p.m.	16:5	5-13 p.m.	17:7	(3) -	40.5 :17	?	0	B, BT,b. Several offsets resembling burst records.	G

a Clock rate seems to accelerate slightly at this point.

b Five offsets at various times resemble bursts. Pencilled but not identified on record.

## KIRKLAND LAKE SEISMOGRAM RECORD

May, 1940

No.	Rec'd	On		Off		Time Correction		Bursts	Quakes	Remarks		
		Time	Date	Time	Date	Value	Amount					
66	5:9	5-16 p.m.	17:5	10-25 a.m.	18:5	(3)	- 40.5	: 5	?	0	B,BT. Esterline-Angus recorder in operation in vault.	G
67	"	10-29 a.m.	18:5	1-40 p.m.	19:5	-	-		?	0	B,BT. Not much disturbance registered.	JM
68	"	1-44 p.m.	19:5	3-48 p.m.	20:5	(3)	- 50.	: <u>15</u>	2	0	a. Sunday record. Two bursts (?) registered.	G
68A	"	10-10 p.m.	20:5	4-00 p.m.	21:5	(3)	- 52.5	: <u>16</u>	?	0	B,BT. Very low gain these days.	G
69	"	4-03 p.m.	21:5	4-03 p.m.	22:5	(3)	- 56.	: <u>16</u>	?	0	B,BT. Correlation very meagre.	G
70	"	4-05 p.m.	22:5	5-03 p.m.	23:5	(3)	- 58.	: <u>22</u>	?	0	B,BT.	G
71	"	5-06 p.m.	23:5	4-04 p.m.	24:5	(3)	- 62.5	: <u>16</u>	?	0	B,BT,b,c. Attempt connect E-A. in parallel fails.	G
72	"	4-05 p.m.	24:5	4-01 p.m.	25:5	(3)	+ 10.	: <u>16</u>	?	0	B,BT.	G
73	"	4-03 p.m.	25:5	5-05 p.m.	26:5	(3)	+ 12.	: <u>17</u>	?	0	B,BT.	G
74	"	10-16 p.m.	27:5	3-45 a.m.	28:5	(3)	+ 13.	: <u>12</u>	?	0	B,BT,d.	G
74A	"	8-40 a.m.	28:5	6-35 p.m.	28:5	(3)	+ 14.	: <u>16</u>	?	0	B,BT.	G
75	"	6-38 p.m.	28:5	4-38 p.m.	29:5	(3)	+ 15.5	: <u>10</u>	?	0	B,BT. Several offsets. No correlation.	G
76	"	4-40 p.m.	29:5	5-08 p.m.	30:5	(3)	+ 17.	: <u>16</u>	?	0	B,BT. Several offsets. No correlation.	G
77	"	5-10 p.m.	30:5	5-23 p.m.	31:5	(3)	+ 18.	: 9	?	0	B,BT.	G
78	"	5-23 p.m.	31:5	4-01 p.m.	1:6	-	+ 20.	: <u>16</u>	?	0	B,BT.	G

a Burst records (?) marked "I" and "II" and "See E-A. record".

b Turning the RHO receiver switch on or off affects the record as shown by notes thereon.

c Reset chronometer and turned timing screws out at 4 p.m. May 24.

d No record for May 26-27. No explanation. Ink supply failed at 3-45 a.m. on 28th.

KIRKLAND LAKE SEISMOGRAM RECORD  
June, 1940

No.	Rec'd	On		Off		Time Correction		Bursts	Quakes	Remarks	
		Time	Date	Time	Date	Value	Amount				
79	5:9	4-03 p.m.	1:6	11-11 a.m.	2:6	(3)	+ 20. :16	?	0	B,BT. No correlation.	G
80	"	11-14 a.m.	2:6	7-18 a.m.	3:6	(3)	+ 22.5 :10	0	0	Quiescent. Sunday record.	G
81	"	7-20 a.m.	3:6	7-03 a.m.	4:6	(3)	+ 24.5 :18	?	0	Very quiet - some offsets but small.	G
82	"	7-06 a.m.	4:6	8-11 a.m.	5:6	(3)	+ 25.5 : 9	?	0	A number of sharp offsets. BT is strong B weak.	G
83	"	8-13 a.m.	5:6	10-23 a.m.	6:6	(3)	+ 26.5 :10	?	0	B,BT. Number sharp offsets. Not correlated on record.	G
84	"	10-25 a.m.	6:6	8-55 a.m.	7:6	(3)	+ 28.5 : 9	?	0	B,BT. Number sharp offsets. Not correlated on record.	G
85	"	8-57 a.m.	7:6	8-03 a.m.	8:6	-	-	1	0	B,BT,a. Scorched spot on sheet.	G
86	"	8-06 a.m.	8:6	8-40 a.m.	9:6	(3)	+ 31. : 9	1+?	0	B,BT,b. Scorched spot on sheet.	G
87	"	8-42 a.m.	9:6	7-42 a.m.	10:6	-	-	0	0	Sheet practically quiescent. Sunday record.	G
88	"	7-43 a.m.	10:6	8-35 a.m.	11:6	(3)	+ 32. :16	0	0	B,BT. Hours incorrectly entered on sheet. Scorched.	G
89	"	(7-35) a.m.	11:6	7-23 a.m.	12:6	-	-	0	0	B,BT,c. Pen seems to have friction.	G
90	"	7-26 a.m.	12:6	9-09 a.m.	13:6	(3)	+ 35.5 : 7	?	0	B,BT. Some offsets but no correlation.	G
91	"	9-11 a.m.	13:6	4-56 p.m.	14:6	-	-	?	0	B,BT. About 1.5 hours missed to 9-47 p.m.	G
92	"	4-58 p.m.	14:6	3-56 p.m.	15:6	-	-	?	0	B,BT. Hours incorrectly identified. Pen friction.	G
93	"	3-58 p.m.	15:6	11-43 a.m.	16:6	(3)	+ 37. :16	?	0	B,BT,d. Pen friction part of the day.	G
a	Well marked bump at about 4-11 a.m. Marked "bump", no correlation. About 2.7 hours lost 5-40 to 6-10 p.m. 8 to 10.15 p.m.										
b	Well marked bump at 6-39 a.m. Marked "bump", Correlation not given. Other sharp offsets not identified.										
c	Record greatly disturbed in testing of Inco amplifier. Something wrong about hour identification. cf. 88 and 89.										
d	For records 87-93 the time corrections are on desk memorandum only. Not entered on records.										
e	The records for the first half of June are very poor, are not correlated, and have several errors in annotation.										

KIRKLAND LAKE SEISMOGRAM RECORD

June, 1940

No.	Rec'd	On		Off		Time Correction		Bursts	Quakes	Remarks
		Time	Date	Time	Date	Value	Amount			
94	5:9	11-46 a.m.	16:6	11-47 a.m.	17:6	-	-	?	0	B,BT. Clean record. Low gain. No correlation. ?
95	"	11-49 a.m.	17:6	8-25 a.m.	18:6	(2)	+ 39.5 : 9	1	0	B,BT,a. ?
96	"	8-27 a.m.	18:6	1-32 p.m.	19:6	-	-	?	0	B,BT. Several heavy offsets. No correlation. ?
97	"	1-33 p.m.	19:6	2-18 p.m.	20:6	(3)	+ 42. : 9	1	0	B,BT,b. Bump not located but identified 2-17 a.m. 20th. ?
98	"	2-24 p.m.	20:6	3-49 p.m.	21:6	(3)	+ 43. : 11	?	0	B,BT,b. Ink supply failed 3-49. G
99	"	4-32 p.m.	21:6	3-01 p.m.	22:6	(3)	+ 44.5 : 13	?	0	B,BT,b. Fresh ink supply to pen. ?
100	"	4-03 p.m.	22:6	1-22 p.m.	23:6	-	-	?	0	B,BT. Several sharp offsets. No correlation. ?
101	"	1-23 p.m.	23:6	11-52 a.m.	24:6	-	-	-	0	Quiet record (Sunday). Some slight offsets. Cause? ?
102	"	11-54 a.m.	24:6	12-34 p.m.	25:6	(3)	+ 46.5 : 12	?	0	B,BT,b. Several sharp offsets. No correlation. Low gain. ?
103	"	12-36 p.m.	25:6	4-01 p.m.	26:6	(1)	+ 47. : 10	?	0	B,BT,b. Several sharp offsets. No correlation. Low gain. ?
104	"	4-02 p.m.	26:6	4-30 p.m.	27:6	(3)	+ 48.5 : 8	?	0	B,BT,b. Several sharp offsets. No correlation. Low gain. ?
105	"	4-32 p.m.	27:6	6-42 p.m.	28:6	(3)	+ 50. : 8	?	0	B,BT,b. Several sharp offsets. No correlation. Low gain. ?
106	"	6-47 p.m.	28:6	5-38 p.m.	29:6	(3)	+ 50.5 : 7	?	0	B,BT,b,c. Several sharp offsets. No correlation. Low gain. ?
107	"	5-40 p.m.	29:6	6-46 p.m.	30:6	(2)	+ 51. : 12	?	0	B,BT,b. Several sharp offsets. No correlation. Low gain. ?
108	"	6-48 p.m.	30:6	6-51 p.m.	1:7	(3)	+ 52.5 : 15	0	0	BT,b. Fairly quiet Sunday record. No burst(?) offsets. ?
a	Bump	in 3001W stope east of Sec. 10 at 2-11 a.m. ca. on 18th. Interruption to line 4-09 to 5-10 and 6-30 to 7-05 all p.m. 17th.								
b	Time	signal in tabulation only. Not entered on record.								
c	Blast	on surface by safety engineer destroying dynamite 8-47-02 a.m. on 29th. Broke 59 window panes. No record.								

## KIRKLAND LAKE SEISMOGRAM RECORD

July, 1940

No.	Rec'd	On		Off		Time Correction		Bursts	Quakes	Remarks	
		Time	Date	Time	Date	Value	Amount				
109	5:9	6-54 p.m.	1:7	5-53 p.m.	2:7	(3)	+ 53.5 : 9	3	0	a,b. Quiet record (Holiday?). Restored Heiland geophone. <u>G</u>	
110	"	5-57 p.m.	2:7	8-06 p.m.	3:7	(3)	+ 54.5 : 10	?	0	B, BT, b, c. Notably greater sensitivity. <u>?</u>	
111	"	8-08 p.m.	3:7	7-30 p.m.	4:7	-	-	?	0	B, BT. Much disturbance a.m. 4th. Some one in vault? <u>?</u>	
112	"	7-31 p.m.	4:7	11-45 p.m.	5:7	-	-	?	0	B, BT, c, d. <u>G?</u>	
113	"	12-02 p.m.	5:7	2-49 p.m.	6:7	-	-	?	0	B, BT, c, e. Some time relay trouble first quarter record. <u>G?</u>	
S3	Series S3 using re-conditioned Heiland recorder begins here.								July 2 - 6 both recorders operated.		<u>G?</u>
1	5:9	5-52 p.m.	2:7	8-02 p.m.	3:7	-	-	3?	0	Is. Record line much too heavy. <u>G?</u>	
2	"	8-04 p.m.	3:7	8-47 p.m.	4:7	-	-	1?	0	Is. No record sheet for July 4-5. <u>?</u>	
3	"	8-55 p.m.	5:7	9-22 a.m.	6:7	-	-	0	0	Good line intensity but no offsets of any kind. <u>?</u>	
4	"	10-24 a.m.	6:7	9-52 a.m.	7:7	(2)	+ 1.0 : 14	1?	0	b, e, f. Good line intensity. One slight offset only. <u>?</u>	
5	"	9-54 a.m.	7:7	9-34 a.m.	8-7	(2)	+ 2.0 : 15	1?	0	b, f. Good line intensity. One slight offset only. <u>?</u>	
6	"	9-36 a.m.	8:7	10-43 a.m.	9:7	-	-	0	0	Line fair. Time marks fail most of the record. <u>?</u>	
7	"	10-45 a.m.	9:7	9-03 a.m.	10:7	-	-	1?	0	Time marks lacking for entire record. <u>?</u>	
8	"	9-05 a.m.	10:7	9-04 a.m.	11:7	(3)	+ 8.0 : 9	0	0	b. Timing restored. Line good. Absolutely quiet. <u>?</u>	
9	"	9-05 a.m.	11:7	10-11 a.m.	12:7	-	-	1?	0	f. One slight offset. Good line. Timing OK. <u>?</u>	
10	"	10-13 a.m.	12:7	11-57 a.m.	13:7	3	+ 9.5 : 12	1?	0	Is, f, g. One slight offset. Line intensity stepped up. <u>?</u>	
a	Bumps at 2-30-51, 2-40-45, and 2-41-50. Location not indicated. Quite moderate offsets (.3 in.).										
b	Correction from tabulation only. Not recorded on seismogram. (f) No correlation.										
c	A number of offsets suggesting bumps but no correlation. (g) Correction from key signal on record.										
d	Time relay disconnected about 12:30 a.m. in favour of photographic instrument being installed.										
e	Chronometer reset at 2 p.m. on July 6.										



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, 1940

No.	Rec'd	On		Off		Time Correction		Bursts	Quakes	Remarks	
		Time	Date	Time	Date	Value	Amount				
11	5:9	11-59 a.m.	13:7	11-31 a.m.	14:7	-	-	3?	0	B,d,e. Line heavy but good. LS. blasting shows.	?
12	"	11-33 a.m.	14:7	10-10 a.m.	15:7	3	+ 13. : 10	0	0	a,b. Quiescent (Sunday record).	?
13	"	10-11 a.m.	15:7	11-37 a.m.	16:7	3	+ 14.5 : 2	3+?	0	B,b,e. Daytime LS. blasting (?) unusually heavy.	?
14	"	11-38 a.m.	16:7	11-29 a.m.	17:7	-	-	3+?	0	B,e. Three large, some small offsets 3 p.m. ±5 min.	?
15	"	11-30 a.m.	17:7	12-51 a.m.	18:7	-	-	2?	0	B. Good but strong line intensity this period.	?
16	"	12-53 p.m.	18:7	1-36 p.m.	19:7	3	+ 16. : 0	?	0	BT,a,b,e. No LS. blasting shows.	?
17	"	1-44 p.m.	19:7	12-49 p.m.	20:7	-	-	?	0	?e,f. Testing on record. No notes. Amplifier installed?	?
18	"	2-20 p.m.	20:7	12-noon	21:7	-	-	1	0	Amplifier on. No time marks. FERROTYPING BEGAN HERE.	?
19	"	12-10 p.m.	21:7	2-23 p.m.	22:7	-	-	2	0	Amplifier on first half, then removed. Line OK.	?
20	"	?	22:7	?	23:7	-	-	0	0	Iw,F,S,g. Record useless. Weak line.	?
21	"	?	23:7	?	23:7	-	-	0	0	F,g. No record visible at all.	?
22	"	8-13 p.m.	23:7	7-43 a.m.	24:7	-	-	0	0	Iw,F,S. Sheet run 60 mm/min. Quiescent.	?
23	"	7-50 a.m.	24:7	8-12 p.m.	24:7	-	-	0	0	Is. Record entirely useless. Overexposed.	?
24	"	8-52 a.m.	24:7	9-04 a.m.	25:7	3	+ 25.5 : 2	0	0	Iw,(F),c,h. Line shows no offsets whatever.	?

a Time correction from desk memorandum.   b. Time correction from key signal on record.  
c Time correction from registered automatic signals.   e. No correlation.  
d Large earthquake in Aleutian Islands occurred during this sheet. No trace shows.  
f Amplifier installed here? Record a blur from then on. Testing on sheet. No correlation.  
g Sheet put on upside down.   h. Suspect that sensitivity dial must be at zero inadvertently.  
i Sheets during period July 20-25 were not good records. Experimental work being carried on by H.+ G.

KIRKLAND LAKE SEISMOGRAM RECORD

July, 1940

No.	Rec'd	On		Off		Time Correction		Bursts	Quakes	Remarks	
		Time	Date	Time	Date	Value	Amount				
25	5:9	9-05 a.m.	25:7	7-36 p.m.	25:7	-	-	1?	0	(F). Good strong line. Still 60 mm/min.	?
26	"	7-39 p.m.	25:7	7-45 a.m.	26:7	-	-	0	0	Is,a,e,f. Sheet stuck to ferrottype slightly. Quiescent.	G
27	"	7-46 a.m.	26:7	2-43 p.m.	26:7	(3)	+ 27. : 9	0	0	a,f,g. Sheet much spoiled by overwashing. Quiescent.	?
28	"	8-00 p.m.	26:7	8-55 a.m.	27:7	-	-	0	0	f. No time signals on this record.	?
29	"	5-20 p.m.	27:7	6-45 a.m.	28:7	-	-	2	0	h,i. RECORD USING SCREEN ON CYLINDRICAL LENS (FIRST).	?
30	"	6-46 a.m.	28:7	11-45 a.m.	28:7	(3)	+ 29.5 : 11	0	0	Is,a,c.	?
31	"	2-56 p.m.	28:7	3-58 p.m.	29:7	(3)	+ 31.5 : 8	0	0	(Is),a,c,f.	?
32	"	4-01 p.m.	29:7	4-05 p.m.	30:7	-	-	1?	0	(Is). Some sensitivity discernible but not much.	?
33	"	4-07 p.m.	30:7	3-23 p.m.	31:7	-	-	4+?	0	Is,(B),(BT). Sensitivity distinctly improved.	?
34	"	3-25 p.m.	31:7	3-18 p.m.	1:8	3	+ 34. : 16	1+1?	0	Is. Large burst 10-13-18.5 a.m. Aug. 1. Good record.	?

- a Time corrections from desk memoranda.    b. Time corrections from key signals on record.  
 c Time corrections from radio signals automatically recorded.    d. Paper speed 60 mm/min.  
 e Electric storm. Power off numerous times on evening of 25th.    f. Record seems totally lacking in sensitivity.  
 g Clockwork stopped at 2-43 p.m. on 26th.    h. Two small bursts about 6-26 a.m. on 28th. Felt by E.A.H.  
 i Sheet on emulsion side down but record discernible throughout.

KIRKLAND LAKE SEISMOGRAM RECORD  
August, 1940

No.	Rec'd	On		Off		Time Correction		Bursts	Quakes	Remarks	
		Time	Date	Time	Date	Value	Amount				
35	5:9	3-21 p.m.	1:8	9-45 a.m.	2:8	-	-	3?	0	BT. Good record. Screen not in adjustment.	?
36	"	9-58 a.m.	2:8	9-03 a.m.	3:8	3	+ 38. :17	1+?	0	B,BT,(F),c,d. Large burst 6-15 ea.p.m. Aug. 2.	?
37	"	11-33 a.m.	3:8	8-45 a.m.	4:8	3	+ 39. :14	3+?	0	Is,(F),(B),(BT),c,e. Three well recorded bursts.	?
38	"	?	4:8	9-26 a.m.	5:8	3	+ 40. : 9	?	0	Iw,F,c,e'. Something wrong with time identification.	?
39	"	9-30 a.m.	5:8	10-30 a.m.	6:8	2	+ 43. :17	0	0	(B),c,f. Excellent line. Sensitivity seems low.	?
40	"	9-46 a.m.	6:8	9-31 a.m.	7:8	3	+ 45. : 8	1	0	B,BT,(F),g,c. Large bump 4301E Dr. 4-12-31 a.m. 7th.	G
41	"	9-35 a.m.	7:8	8-34 a.m.	8:8	3	+ 47. : 8	0	0	B,(BT),c. Good screen lines this period.	G
42	"	8-39 a.m.	8:8	11-58 a.m.	9:8	(3)	+ 49. : 8	2	0	(S),(F),a. Two small bursts? No correlation.	G
43	"	11-59 a.m.	9:8	10-42 a.m.	10:8	-	-	2	0	B,BT,(S). Two small bursts? No correlation.	G
44	"	10-43 a.m.	10:8	11-31 a.m.	11:8	(2)	+ 51. :11	0	0	Quiescent record. No record Aug. 11-12.	G
45	"	10-42 a.m.	12:8	8-54 a.m.	13:8	(3)	+ 55.5 :16	0	0	(F). Quiescent. Good record line.	?
46	"	8-59 a.m.	13:8	8-03 a.m.	14:8	(2)	+ 59. : 8	0	0	(B), (BT). During this period line good but heavy.	G
47	"	8-34 a.m.	14:8	10-41 a.m.	15:8	(3)	+ 60. : 8	6	0	(B),(BT). Six small offsets.	?
48	"	10-57 a.m.	15:8	11-34 a.m.	16:8	-	-	2	0	No blasting shows. One large, one small burst. (h),i.	?

a Corrections from desk memoranda. b. Corrections from key signals. c. Corrections from automatic signals.

d One of the best screen lens records so far. e. Bursts recorded at 12-40, 6-02 and 6-03 all a.m. on 4th.

e Record too faint to be of service. f. Time as identified is one hour out of. Nos. 39-40.

g Records during this period are finger marked at ends.

h Large burst at 2-33-44.5 p.m. on 15th. Smaller one in 3811 (East Pillar) at 3-02-32 a.m. on 16th.

i Line intensity adjusted to minimum beginning on sheet 48 after long run heavy but good line.

KIRKLAND LAKE SEISMOGRAM RECORD

August, 1940

No.	Rec'd	On		Off		Time Correction		Bursts	Quakes	Remarks
		Time	Date	Time	Date	Value	Amount			
49	5:9	11-38 a.m.	16:8	10-17 a.m.	17:8	1	+ 63. :12	1	0	(B). Small burst (?) 6-44 a.m. ca. No correlation. ?
50	"	10-19 a.m.	17:8	1-10 p.m.	18:8	(2)	+ 66. :11	1	0	S. Quiescent (Sunday). Small burst. No correlation. ?
51	"	1-11 p.m.	18:8	1-19 p.m.	19:8	(2)	+ 66.5 : 2	0	0	S. Quiescent. Something wrong with time identification. ?
52	"	3-20 p.m.	19:8	2-18 p.m.	20:8	2	+ 68. : 2	1	0	(B), (BT). Excellent line. No correlation. ?
53	"	2-19 p.m.	20:8	11-00 a.m.	21:8	3	+ 69. : 7	1	0	(B), (BT), a, b. Faint traces only of blasting. No correlation. ?
54	"	11-13 a.m.	21:8	11-46 a.m.	22:8	-	-	2?	0	c. Quiescent except for two small bursts (?) ?
55	"	1-47 p.m.	22:8	1-49 p.m.	23:8	3	+ 70.5 :14	1?	0	Quiescent except for one small burst (?) ?
56	"	1-50 p.m.	23:8	3-24 p.m.	24:8	3	+ 72.5 : 7	?	0	(B), (BT). Line becoming heavier but still good. ?
57	"	3-26 p.m.	24:8	12-49 p.m.	25:8	-	-	2?	0	B, BT, (S), d. ?
58	"	12-50 p.m.	25:8	11-15 a.m.	26:8	(3)	+ 75. : 7	2?	0	Quiescent except two bursts (?) one very small. ?
59	"	11-16 a.m.	26:8	9-53 a.m.	27:8	3	+ 76.5 : 8	1+3?	0	S, e. Line adjusted to fine once more. ?
60	"	9-54 a.m.	27:8	10-56 a.m.	28:8	3	+ 77.5 : 2	4?	0	(B), (BT), f. Two moderate + two small bursts (?) ?
61	"	10-57 a.m.	28:8	12-04 p.m.	29:8	-	-	0	0	Practically quiescent. (BT?) ?
62	"	12-05 p.m.	29:8	2-34 p.m.	30:8	-	0 :14	1	0	(BT), S, g. Moderate burst (?) 3-04 a.m. on 30th. ?
63	"	2-35 p.m.	30:8	4-04 p.m.	31:8	(3)	+ 3.5 :10	1	0	(B), (BT), S, c. Large burst 12-10-45 a.m. on 31st. ?
64	"	4-05 p.m.	31:8	3-14 p.m.	1:9	-	-	1	0	(BT), c. Large burst 11-33-45 p.m. on 31st. ?

a Well marked burst (?) Not correlated. Lasted about 2 sec. About 4-29 a.m. on 21st.

b Sheet 53, typical of this period for line intensity, could be used as a sample for standard setting.

c No correlation. Time identification not made on sheet as returned to Ottawa. Missing on 51-53 and only occasionally entered partially up to No. 64. f. Sheet damaged by sticking to ferrotype tin.

d Seems to show LS. blasting on a Sunday morning at about 2.30. No correlation.

e Large burst about 4-41. Lasted about 4 seconds. g. Chronometer reset to 0 correction 3 p.m. on 29th.

KIRKLAND LAKE SEISMOGRAM RECORD  
September, 1940

No.	Rec'd	On		Off		Time Correction		Bursts	Quakes	Remarks	
		Time	Date	Time	Date	Value	Amount				
65	3:10	3-16 p.m.	1:9	3-46 p.m.	2:9	2	+ 5.5 :16	1	0	a. Good line. No blasting shows. One burst (?)	?
66	"	3-48 p.m.	2:9	4-26 p.m.	3:9	3	+ 9. : 8	2	0	(B),(BT),a. Two small bursts(?) Good fine line.	?
67	"	4-27 p.m.	3:9	3-05 p.m.	4:9	3	+ 11.5 :15	0	0	B,BT,F,b. Blasting well recorded. Good line.	?
68	"	3-08 p.m.	4:9	3-07 p.m.	5:9	0	-	4	0	B,BT,F,a. Four bursts (?) one fair size.	?
69	"	3-10 p.m.	5:9	3-04 p.m.	6:9	3	+ 16. :15	3	0	B,(BT),F,a. Two bursts (?) Two very small.	?
70	"	3-07 p.m.	6:9	11-01 a.m.	7:9	3	+ 17.5 :11	5	0	BT,(F),a. Five small bursts (?)	?
71	"	11-21 a.m.	7:9	1-03 p.m.	8:9	-	-	8	0	B,(BT),F,S,a. Eight small bursts (?)	?
72	"	1-04 p.m.	8:9	11-12 a.m.	9:9	3	+ 22. :11	?	0	F. Quiescent except small offsets 3-09 to 3-11 p.m. 8th.	?
73	"	11-43 a.m.	9:9	10-56 a.m.	10:9	-	-	2	0	B,BT,F,S,a. Two bursts(?) one of moderate size.	?
74	"	10-58 a.m.	10:9	10-37 a.m.	11:9	0	-	0	0	B,(BT),F,a,d,f. Prints finger marked during this period.	?
75	"	10-39 a.m.	11:9	10-55 a.m.	12:9	3	+ 25.5 :11	0	0	(B),(BT),F,S,a.	?
76	"	10-57 a.m.	12:9	10-53 a.m.	13:9	0	-	1	0	B,BT,F,S,a,e,f. One small burst (?)	?
77	"	10-55 a.m.	13:9	10-19 a.m.	14:9	3	+ 29.0 :11	1	0	(B),(BT),F,S,a. One small burst (?)	?
78	"	10-53 a.m.	14:9	12-07 p.m.	15:9	3	+ 32. :11	1	0	No blasting registered. One fair sized burst (?)	?
79	"	12-11 p.m.	15:9	11-17 a.m.	16:9	-	-	1	0	a. No blasting registered. One small burst?	?

a No correlation. b. Not ferrotyped during this period. c. Lines during this period are excellent.  
d This time signal does not fit in with what precedes. No indication of clock rate having been changed (?)  
e Sheets stained and some fading badly. Fixer was probably too shallow, too weak, or too little time was allowed.  
f Time signal is useless.

KIRKLAND LAKE SEISMOGRAM RECORD  
September, 1940

No.	Rec'd	On		Off		Time Correction		Bursts	Quakes	Remarks	
		Time	Date	Time	Date	Value	Amount				
80	3:10	11-19 a.m.	16:9	10-44 a.m.	17:9	2	+ 36.5 :14	1?	0	a,b. Quiescent. Good record line during this period.	?
81	"	10-46 a.m.	17:9	10-49 a.m.	18:9	0	-	1	0	B,BT,a,b,c.	?
82	"	10-51 a.m.	18:9	11-15 a.m.	19:9	3	+ 41.5 :11	0	0	BT,a,b.	?
83	"	11-17 a.m.	19:9	11-04 a.m.	20:9	3	+ 45.5 :11	3	0	B,BT,a,b. Two moderate + one large burst (?)	?
84	"	11-06 a.m.	20:9	10-55 a.m.	21:9	-	-	1?	0	(B),(BT),F,S,a,b,d. No radio signal registered.	B
85	"	10-56 a.m.	21:9	11-22 a.m.	22:9	3	+ 48.5 :11	2	0	F,e. No blasting recorded. Ferrotyping begins again.	H
86	"	11-48 a.m.	22:9	2-16 p.m.	23:9	3	+ 50.5 :16	2?	0	F,a.	H
87	"	2-19 p.m.	23:9	2-16 p.m.	24:9	3	+ 55. :12	6?	0	F,a,f. Line becoming stronger. No blasting recorded.	H
88	"	2-18 p.m.	24:9	11-13 a.m.	25:9	3	+ 57.5 :11	0	0	B,(BT),(F),g.	H
89	"	11-16 a.m.	25:9	1-05 p.m.	26:9	0	-	0	0	B,BT,a,c. Clean sheet. Good line.	H
90	"	1-44 p.m.	26:9	8-15 a.m.	27:9	-	-	5	0	(B),(BT),a. Five bursts (?) one quite large. Good line.	H
91	"	8-16 a.m.	27:9	9-22 a.m.	28:9	3	+ 62.5 :17	2?	0	B,BT,a. Excellent sheet for sample. Good signal.	H
92	"	-	28:9	-	29:9	-	-	-	-	Record lost. Clutch not engaged.	H
93	"	8-07 a.m.	29:9	8-22 a.m.	30:9	2	+ 66. : 9	3?	0	No blasting recorded. Sunday record.	H
94	"	8-23 a.m.	30:9	10-07 a.m.	1:10	3	+ 69.5 :10	3?	0	B,(BT),h.	H

- a No correlation. b. Sheets not ferrotyped. c. Radio signal too poor to yield a correction.  
d May be small burst during LS. blasting. Good example of greater burst amplitude in slight blasting offsets.  
e Two bursts registered. One fairly large at 7-07 p.m. on 20th. Sheet slightly damaged on ferrotyping.  
f Six very small offsets may be slight bursts. g. Sheets finger marked this period when put in service can.  
h Record interrupted 9-09 to 9-20 a.m. on 30th for visit by Prof. Langton. Line ran off at bottom of sheet at 10-07.

KIRKLAND LAKE SEISMOGRAM RECORD  
October, 1940

No.	Rec'd	On		Off		Time Correction		Bursts	Quakes	Remarks	
		Time	Date	Time	Date	Value	Amount				
95	3:10	11-08 a.m.	2:10	3-01 p.m.	2:10	3	+ 75.5	:15	0	0	(B), a, b. <span style="float: right;">H.</span>
96	"	3-03 p.m.	2:10	11-03 a.m.	3:10	-	-		2?	0	B, BT, (G), a. Time identification on sheet incorrect 2 hrs.?
97	24:10	11-04 a.m.	3:10	11-42 a.m.	4:10	(3)	+ 79.	:12	0	0	B, BT, a, c, d. Time correction from note only. <span style="float: right;">?</span>
98	"	11-44 a.m.	4:10	12-48 p.m.	5:10	3	+ 81.	: 8	1?	0	B, BT, a. Good record line. <span style="float: right;">?</span>
99	"	12-49 p.m.	5:10	2-40 p.m.	6:10	3	+ 81.5	:13	3	0	B, BT, (F), e. <span style="float: right;">?</span>
100	"	2-41 p.m.	6:10	3-11 p.m.	7:10	1	+ 87.0	:15	0	0	Quiescent, no blasting recorded. <span style="float: right;">?</span>
101	"	3-13 p.m.	7:10	2-08 p.m.	8:10	1	+ 89.	:14	1+1?	0	(B), F, f. Ferrotyping stops with sheet 100. <span style="float: right;">?</span>
102	"	2-13 p.m.	8:10	2-01 p.m.	9:10	1	+ 91.	:14	?	0	Is, B, BT. <span style="float: right;">?</span>
103	"	2-03 p.m.	9:10	2-02 p.m.	10:10	3	+ 92.5	:14	10?	0	Is, (B), (BT). Very weak offsets. Blasts (?) <span style="float: right;">?</span>
104	"	2-04 p.m.	10:10	11-03 a.m.	11:10	3	+ 95.	:11	?	0	Is, (B), (BT). <span style="float: right;">?</span>
105	"	11-06 a.m.	11-10	11-02 a.m.	12:10	3	+ 97.	:11	2+	0	Is, B, BT, g. <span style="float: right;">?</span>
106	"	11-04 a.m.	12:10	10-02 a.m.	13:10	3	+ 98.5	:10	?	0	Is, (B), (BT). <span style="float: right;">?</span>
107	"	11-04 a.m.	13:10	11-01 a.m.	14:10	3	+101.	:11	3+	0	Is, (B), (BT), h. <span style="float: right;">?</span>
108	"	11-03 a.m.	14:10	11-05 a.m.	15:10	3	+103.	:11	?	0	Is, (B), (BT). Several small offsets: bursts (?) <span style="float: right;">?</span>

- a No correlation. b. Clutch not closed at 11-30 a.m. Oct. 1. So no record till 11-08 a.m. Oct. 2.
- c Time contact stuck shut at 2-49 a.m. on 4th. Line became heavier and had no signals to end of record.
- d Sheet cracked in removing from ferrotype. e. Large burst 2-54-51.5 p.m. on 5th. Duration 2 sec. Location 4302E4.
- f Large burst at 9-15-39 p.m. on 7th. Duration 3 sec. Location not given. Note correction is +90 sec. but record gives +89 sec.
- g Large burst at 4-38.5 a.m. on 12th. Duration about 5 sec. + "aftershocks (?)".
- h Large burst at 7-02 p.m. on 13th and another at 7-20 a.m. on 14th with small burst at 8-11 p.m. on 13th. Location (?)

KIRKLAND LAKE SEISMOGRAM RECORD  
October, 1940

No.	Rec'd	On		Off		Time Correction		Bursts	Quakes	Remarks	
		Time	Date	Time	Date	Value	Amount				
109	24:10	11-08 a.m.	15:10	11-03 a.m.	16:10	3	+105. :11	1?	0	Is, (B), (BT).	?
110	"	11-05 a.m.	16:10	12-08 p.m.	17:10	2	+107. :12	?	0	Is, (B), a. Nice clean records at this period. Line heavy.	?
111	"	12-10 p.m.	17:10	11-02 a.m.	18:10	3	+108.5 :11	0	0	Is, B, BT. Focus seems extra good this period.	?
112	"	11-04 a.m.	18:10	10-00 a.m.	19:10	3	+110. :10	4	0	Is, (B), (BT), b. BURST SERIES OF INTEREST.	?
113	25:11	10-02 a.m.	19:10	12-08 p.m.	20:10	2	+111. :12	1	0	Is, c. No blasting recorded. (Sunday record).	?
114	"	12-10 p.m.	20:10	11-06 a.m.	21:10	2	+113. :11	0	0	Is, c. Quiescent record.	?
115	"	11-07 a.m.	21:10	11-01 a.m.	22:10	-	-	1+4?	0	Is, (B), e. Four small offsets within minute.	?
116	"	11-03 a.m.	22:10	11-01 a.m.	23:10	3	+116.5 :11	?	0	Is, B, BT, c.	?
117	"	11-03 a.m.	23:10	11-01 a.m.	24:10	2	- 1. :11	1+2?	0	Is, B, BT, d, e. CHRONOMETER RESET.	?
118	"	11-03 a.m.	24:10	11-03 a.m.	25:10	2	+ 1. :11	1?	0	Is, B, BT. Blasting sharply recorded.	?
119	"	11-05 a.m.	25:10	1-40 p.m.	26:10	-	-	0	0	(B). Spot corrected to normal intensity 5-34 p.m. 25th.	G
120	"	1-58 p.m.	26:10	4-41 p.m.	27:10	1	+ 3.5 :14	1?	0	B, f. FERROTYPING BEGINS AGAIN.	?
121	"	5-19 p.m.	27:10	6-24 p.m.	28:10	1	+ 7.0 : 9	0	0	B. Nice clean fine line sheet.	?
122	"	6-26 p.m.	28:10	4-02 p.m.	29:10	2	+ 9.5 :10	1	0	B, e. Moderately large bump. Duration 2 sec.	?
123	"	4-04 p.m.	29:10	3-45 p.m.	30:10	-	-	1+1?	0	B, BW?. Blasting (3) about 1-21 a.m. on 30th.	?
124	"	3-47 p.m.	30:10	3-40 p.m.	31:10	2	+ 13.5 :10	2	0	B?, e, f. Blasting (?) about 3-16 a.m. on 31st.	?

a Clock rate diminishes at this date. No explanation given.

b Four large bursts: 2-46-08; 2-47-29; 2-48-41; 2-52-19; all a.m. on 19th. Duration of first about 20 sec. Location?

c Something wrong with time correction as given in notes. It does not agree at all with recorded correction.

d Small burst 3-12-30 a.m. on 24th in W. vein. S. side 600' level.

e Rock burst record from mine: (21st) 2-34-38.5; (24th) 3-12-25.5; (29th) 11-46-56; (30th) 2-43-44; (31st) 2-25-35; (31st) 2-56-43; all "small", a.m. or p.m. not indicated. Location not given.

f Sheet over-run. Last part of record lost. cf. change times.



KIRKLAND LAKE SEISMOGRAM RECORD  
November, 1940

No.	Rec'd	On		Off		Time Correction		Bursts	Quakes	Remarks	
		Time	Date	Time	Date	Value	Amount				
125	25:11	6-51 p.m.	31:10	6-55 p.m.	1:11	-	-	2?	0	(B).	?
126	5:12	6-56 p.m.	1:11	4-58 p.m.	2:11	3	+ 17.5 : 2	5	0	B,a. Five well-marked bursts, one fairly large.	G
127	"	4-59 p.m.	2:11	3-25 p.m.	3:11	3	+ 18. : 17	3	0	B?, (after 3-05 a.m.), b, c. Nice clean record.	G
128	"	3-45 p.m.	3:11	5-34 p.m.	4:11	3	+ 21. : 2	2	0	B, BT, d. Two small bursts(?). Sheet torn and (cracked).	G
129	"	5-36 p.m.	4:11	5-02 p.m.	5:11	-	-	1+2?	0	(B), e. Sheet on upside down but record lines show.	G
130	"	5-03 p.m.	5:11	4-45 p.m.	6:11	3	+ 22.5 : 18	1?	0	(B), (BT). Line growing stronger but still good.	G
131	"	4-46 p.m.	6:11	-	7:11	-	-	-	-	Clutch not engaged; no record.	G
132	"	5-24 p.m.	7:11	6-32 p.m.	8:11	3	+ 26. : 8	0	0	B, BT. Nice clean sheet.	G
133	"	6-34 p.m.	8:11	3-47 p.m.	9:11	3	+ 27. : 2	2	0	B. Two small bursts. Location not given.	G
134	"	3-48 p.m.	9:11	4-02 p.m.	10:11	3	+ 28.5 : 14	2	0	(B), (BT)? Two small bursts. Location?	G
135	"	4-02 p.m.	10:11	5-45 p.m.	11:11	-	-	0	0	(F). Blasting not shown (Sunday record).	G
136	"	5-46 p.m.	11:11	7-17 p.m.	12:11	-	-	1+2?	0	f. Power off for short intervals 13 times during night.	G
137	"	7-18 p.m.	12:11	5-56 p.m.	13:11	-	-	3	0	(B), (F). Three small bursts. No location given.	G
138	"	5-57 p.m.	13:11	6-56 p.m.	14:11	3	33. : 2	2+1?	0	(BT?). Two fairly large, one small burst.	G
139	"	6-57 p.m.	14:11	5-51 p.m.	15:11	-	-	?	0	(B), (BT). Line becoming stronger. Still good.	G

- a Sharp burst 3-48 a.m. on 2nd. Location not given. Duration about 3 sec.
- b Two large + one small burst. Duration of large ones about 3 sec. Locations(?). c Clock rate diminishes.
- d List of bursts gives one at 4-21-49 on Nov. 3. Does not state a.m. or p.m. Cannot find one registered.
- e Small burst located at 3301W8. Two interruptions to line, might be bursts. Not identified as such.
- f Moderately large burst at 2-53 a.m. on 12th. No location given. Duration 2 sec. - Total time lost 1<sup>h</sup>18<sup>m</sup>.

KIRKLAND LAKE SEISMOGRAM RECORD

November, 1940

No.	Rec'd	On		Off		Time Correction		Bursts	Quakes	Remarks
		Time	Date	Time	Date	Value	Amount			
140	5:12	5-52 p.m.	15:11	8-53 p.m.	16:11	3	+ 34.5 :18	0	0	(F), a. No trace of blasting or bursts. <span style="float:right">G</span>
141	"	10-21 p.m.	16:11	11-53 p.m.	17:11	3	+ 37. :10	0	0	(B),(S). Line becoming heavier. Still good. <span style="float:right">G</span>
142	"	11-54 p.m.	17:11	10-54 p.m.	18:11	3	+ 37.5 : 0	0	0	(BT). Quiescent (Sunday record). <span style="float:right">G</span>
143	"	10-55 p.m.	18:11	5-17 p.m.	19:11	3	+ 39.0 :23	5?	0	B. Four offsets in 10 sec. at 1-04 p.m. Nov. 19. Cause? <span style="float:right">G</span>
144	"	5-18 p.m.	19:11	4-57 p.m.	20:11	-	-	0	0	B,(BT),(S),b. <span style="float:right">G</span>
145	"	4-59 p.m.	20:11	4-59 p.m.	21:11	3	+ 42. :10	2	0	B,BT,c. Nice clean ferrotyped records this period. <span style="float:right">G</span>
146	"	4-59 p.m.	21:11	4-23 p.m.	22:11	3	+ 44. : 9	1?	0	B,BT. Nice record of blasting. <span style="float:right">G</span>
147	"	5-24 p.m.	22:11	3-00 p.m.	23:11	-	-	1	0	(B),(BT),d. Line is now getting too heavy. cf. 148. <span style="float:right">G</span>
148	"	3-00 p.m.	23:11	3-07 p.m.	24:11	3	+ 46. :12	1+3?	0	B,e. Line strength adjusted. cf. 147. <span style="float:right">G</span>
149	"	3-09 p.m.	24:11	4-33 p.m.	25:11	0	?	2?	0	B. Time circuit broken. No signals. <span style="float:right">G</span>
150	"	4-34 p.m.	25:11	5-15 p.m.	26:11	-	-	1+?	0	(B),(F). Offset in LS. blasting time. <span style="float:right">G</span>
151	"	5-17 p.m.	26:11	3-42 a.m.	27:11	3	+ 48.5 :23	0	0	B. FIRST SHEET EMERGENCY PAPER (NARROW). <span style="float:right">G</span>
152	"	3-49 a.m.	27:11	2-34 p.m.	27:11	-	-	0	0	B. Good LS. blasting record. <span style="float:right">G</span>
153	"	3-50 p.m.	27:11	2-44 a.m.	28:11	-	-	0	0	B,BT. <span style="float:right">G</span>
154	"	2-45 a.m.	28:11	1-38 p.m.	28:11	3	+ 50. : 8	0	0	Quiescent record. <span style="float:right">G</span>
155	"	3-42 p.m.	28:11	2-35 a.m.	29:11	-	-	0	0	Quiescent record. <span style="float:right">G</span>
156	"	2-48 a.m.	29:11	12-50 p.m.	29:11	-	-	0	0	Quiescent record. <span style="float:right">G</span>
157	"	12-52 p.m.	29:11	11-21 p.m.	29:11	3	+ 52. :15	0	0	B. Two large offsets in LS. blasting time. <span style="float:right">G</span>
a	Sheet not changed soon enough. Last part ran off. cf. change times. c. Two small bursts about 2-05 a.m. on 21st.									
b	Loose wire in time circuit cut off signals at 12-23 p.m. on 20th except for intermittent service about 3 p.m.									
d	Large burst at 11-44-45 p.m. on 22nd. Location not given. Duration about 3 sec.									
e	One small burst about 5-09 a.m. on 24th + three rather large offsets in LS. blasting.									

KIRKLAND LAKE SEISMOGRAM RECORD  
November - December, 1940

No.	Rec'd	On		Off		Time Correction		Bursts	Quakes	Remarks	
		Time	Date	Time	Date	Value	Amount				
158	5:12	11-30 p.m.	29:11	10-12 a.m.	30:11	3	+ 53. : 8	1	0	B,a. Large offset 2-52 a.m. on 30th. Location ?	G
159	"	11-59 a.m.	30:11	2-37 p.m.	30:11	-	-	0	0	B.	G
160	"	2-49 p.m.	30:11	1-25 a.m.	1:12	-	-	1?	0	BT?. Small offset about 4-14 p.m. on 30th.	G
161	20:12	10-51 a.m.	1:12	9-36 p.m.	1:12	-	-	1?	0	(B),a.	G
162	"	9-42 p.m.	1:12	8-24 a.m.	2:12	-	-	0	0	Quiescent record.	G
163	"	8-47 a.m.	2:12	6-56 p.m.	2:12	2	+ 56. :12	0	0	B. Good LS. blasting record.	G
164	"	9-26 p.m.	2:12	8-19 a.m.	3:12	-	-	1	0	a. Fairly large burst 2-01 a.m. on 3rd.	G
165	"	8-20 a.m.	3:12	5-47 p.m.	3:12	1	+ 57.5 : 9	3?	0	BT? (about 11-10 a.m.),a. Three offsets in 30 seconds.	G
166	"	6-22 p.m.	3:12	5-04 a.m.	4:12	0	?	0	0	Quiescent record.	G
167	"	5-11 a.m.	4:12	3-30 p.m.	4:12	2	+ 59. : 8	7?	0	Fair sized offsets, one quite large, maybe blasts.	G
168	"	4-09 p.m.	4:12	2-45 a.m.	5:12	-	-	0	0	Quiescent record.	G
169	"	3-05 a.m.	5:12	1-09 p.m.	5:12	-	-	0	0	Quiescent record.	G
170	"	1-10 p.m.	5:12	10-26 p.m.	5:12	-	-	?	0	B,b. FINAL SHEET EMERGENCY PAPER (NARROW).	G

a No correlation. b. Very good record LS. blasting.

c The narrow size emergency sheets (Nos. 151 to 170 inclusive; Nov. 26-Dec. 6) were used to bridge a lack of seismograph paper. There are a few gaps in the recording due to: (a) over-run, (b) failure to preserve every sheet, or (c) light spot falling on crack between adjacent pieces of photographic paper. On the whole the gaps are short. To avoid such emergency conditions, it is necessary for the operator to notify the Ottawa office about a month before his supply on hand is due to be finished. Notification of this particular lack was received at Ottawa on November 23, the letter being dated at Kirkland Lake, Nov. 20.

KIRKLAND LAKE SEISMOGRAM RECORD  
December, 1940

No.	Rec'd	On		Off		Time Correction		Bursts	Quakes	Remarks
		Time	Date	Time	Date	Value	Amount			
171	20:12	12-19 a.m.	6:12	11-27 p.m.	6:12	3	+ 62. :12	?	0	Is,B,BT. Strong LS. blasting record.
172	"	11-28 p.m.	6:12	4-44 p.m.	7:12	1	+ 62.5 :15	?	0	B. Good LS. blasting record (p.m.)
173	"	4-46 p.m.	7:12	3-21 p.m.	8:12	3	+ 63.5 :12	1	0	B,(S),a.
174	1941 4:1	3-22 p.m.	8:12	4-50 p.m.	9:12	3	+ 64.5 : 2	0	0	(B),(S).
175	"	4-51 p.m.	9:12	6-22 p.m.	10:12	3	+ 65.5 : 2	1+?	0	(F),b. Small bursts (?) at 3-08 a.m. on 10th.
176	"	6-23 p.m.	10-12	5-30 p.m.	11:12	3	+ 67. : 2	?	0	B. Blasting (?) again, at 4-11 a.m. on 11th.
177	"	5-31 p.m.	11:12	5-24 p.m.	12:12	3	+ 68.5 :16	4?	0	(B),(S),c. Some very small offsets. Cause?
178	"	5-25 p.m.	12:12	5-49 p.m.	13:12	-	-	?	0	B,BT,(S),d. Good blasting records.
179	"	5-51 p.m.	13:12	6-15 p.m.	14:12	2	+ 70.5 :15	1	0	B,BT,(S),e. Small burst at 2-52-01 a.m. on 14th.
180	"	6-16 p.m.	14:12	1-00 p.m.	15:12	-	-	1+?	0	B,(BT),(F).
181	"	1-00 p.m.	15:12	4-04 p.m.	16:12	3	+ 72.5 : 8	?	0	d,f. Sunday record. Some irregular offsets. Cause?

a Moderate size burst at 6-36 a.m. on 8th.

b A series of small offsets resembling blasting from 4-05 to 4-07 a.m. on 10th. No correlation given.

c A series of small offsets resembling blasting 3-07 to 3-08 p.m. on 12th. No correlation given.

d Sheet badly wrinkled. Seems to have been wet after drying on ferrotype. Perhaps dried in a draught.

e Large amplitude of LS. blasting record attributed to blasting on upper levels of the mine.

f Sheet over-run. No record after 4-04 p.m. Sheet changed at 4-15 p.m.

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KIRKLAND LAKE SEISMOGRAM RECORD  
December, 1940

No.	Rec'd	On		Off		Time Correction		Bursts	Quakes	Remarks	
		Time	Date	Time	Date	Value	Amount				
182	4:1	4-15 p.m.	16:12	4-38 p.m.	17:12	-	-	0	0	B, BT, a.	<u>G</u>
183	"	4-39 p.m.	17:12	4-34 p.m.	18:12	-	-	1	0	BT, (S), (F). Small burst (?) 10-55 p.m. on 17th.	<u>G</u>
184	"	4-35 p.m.	18:12	4-29 p.m.	19:12	3	+ 79. :16	?	1?	B, BT, b, c. Sheets of this period curl very much - crack.	<u>G</u>
185	"	4-30 p.m.	19:12	4-33 p.m.	20:12	3	+ 80. : 2	3	0	B, (F), d, e.	<u>G</u>
186	"	4-34 p.m.	20:12	3-26 p.m.	21:12	3	+ 82. :15	1+?	0	(B), (BT), f, g. Line intensity reduced at 10 a.m. on 21st.	<u>G</u>
187	"	3-29 p.m.	21:12	3-52 p.m.	22:12	3	0 :14	0	0	(F). Line fine. Quiescent record.	<u>G</u>
188	"	3-53 p.m.	22:12	2-28 p.m.	23:12	3	+ 1.5 :10	0	0	True line. Blasting ? at 12-41 p.m. on 23rd.	A + <u>G</u>
189	13:1	2-29 p.m.	23:12	2-08 p.m.	24:12	3	+ 2.5 :14	0	0	B, BT, (S). LS. blasting (?) 3-04 a.m. on 24th.	A + <u>G</u>
190	"	2-10 p.m.	24:12	2-10 p.m.	25:12	0	?	0	0	i. Quiescent record.	<u>A</u>
191	"	12-12 p.m.	25:12	2-03 p.m.	26:12	3	+ 26. :14	2?	0	BT?, Iw, (F).	<u>A</u>
192	"	2-06 p.m.	26:12	2-12 p.m.	27:12	3	+ 27. :14	1?	0	(B), Iw, (F). Blasting ? at 3-38 a.m. on 27th.	<u>A</u>
193	"	2-14 p.m.	27:12	2-02 p.m.	28:12	3	+ 28. :12	2	0	Quiescent except bursts 2-47-07:2-57-39 a.m. on 28th.	<u>A</u>
194	"	12-05 p.m.	28:12	2-16 p.m.	29:12	0	?	1+?	0	B, j. Line improves after heavy burst.	<u>A</u>
195	"	2-18 p.m.	29:12	2-04 p.m.	30:12	3	+ 29. :12	2	0	Quiescent except bursts 10-02-23:10-28-20 p.m. on 29th.	<u>A</u>
196	"	12-06 p.m.	30:12	2-39 p.m.	31:12	3	+ 29.5 :14	2?	0	(B), (BT), (F).	<u>A</u>

- a Chronometer rate increases on Dec. 16. No explanation in notes. f. Small burst 3-22-45 a.m. on 20th.
- b A series of offsets resembling records of LS. blasting appear shortly before 3-30 p.m. on 19th, as well as at the usual time 2-30±.
- c New Hampshire earthquake seems to be recorded for about half a minute at about 2-30 a.m. on 20th.
- d Blasting ? recorded at 3-35 p.m. on 20th. No correlation. g. Chronometer hour signal fails intermittently.
- e Burst (?) of some magnitude at 10-48-24 a.m. on 20th. No correlation. Two smaller offsets probably due to bursts.
- h No trace of second New Hampshire quake on Dec. 24 at about 8-45 a.m.
- i Time signal remained on from 9-44 to 12 noon on Dec. 25. No time for this interval. Chronometer run down.
- j Heavy burst 12-22-30.5. Duration 9 sec. Location not given. Ottawa Benioff not operating at the time. Not registered at Shawinigan Falls nor at Seven Falls.

