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Department of Mines and Resources
Surveys and Engineering Branch

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Dominion Observatory

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SEISMIC RESEARCH PROGRAM
ROCK BURST PROBLEM
LAKE SHORE MINES

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Report No. 11
January - March
1943

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Ernest A. Hodgson
and
Zack E. Gibbs

RESERVE/RÉSERVÉ

**NOT TO BE TAKEN FROM THE ROOM
POUR LA CONSULTATION SUR PLACE**

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OTTAWA

Report No. 11

Part A

Underground Program

88

Ernest A. Hodgson

9

SEISMIC RESEARCH PROGRAM
ROCK BURST PROBLEM
LAKE SHORE MINES

Report No. 11. January - March, 1943

Part A. Underground Program

Ernest A. Hodgson

The general account of the work was brought up to the end of December, 1942, in Report No. 10. The present issue deals with the period January - March, 1943. Mr. Gibbs has prepared a review of Instrument Development, which appears as Part B of this report.

The arrangement of Part A is largely chronological, the necessary preliminary explanations being given in the first four sections. The progress made in the research during the period under review is outlined in sections V - VII. The final section VIII is devoted to a summary of the deductions and recommendations. Following Part B, a series of three appendix tabulations list the details of observations. The analysis of records (Appendix II) has been carried through to the end of March; but, as the data for February and March were, of necessity, too meagre to permit any deductions to be made, only those for January are presented.

I. Recording Program in January: As explained in the preceding report, the preliminary work (determining the best locale for the investigation, eliminating instrument trouble, and initiating a regular program) was completed by the end of December, 1942. The program, as developed, was carried through regularly during January.

Three sets of Obert recorders were available, together with seven geophones. The recorders were set as follows. One was stationed in a doghouse (underground instrument room built in the side of the drift) on 3801W9 and recorded alternately, by means of a time switch, from a geophone in H29 (Hole No. 29; see Appendix I for location of holes) in 3801W10 and from another in E31 in 3908W7, the cable for the latter reaching the upper level via the manway rising from the 3950' level at Sec. 6.3W. Two others were placed in the doghouse on 4201W6. One of these alternately served H27 in 4001W7 and H24 in 4301W7, the cable for the former coming down through the manway rising from 4200' level at

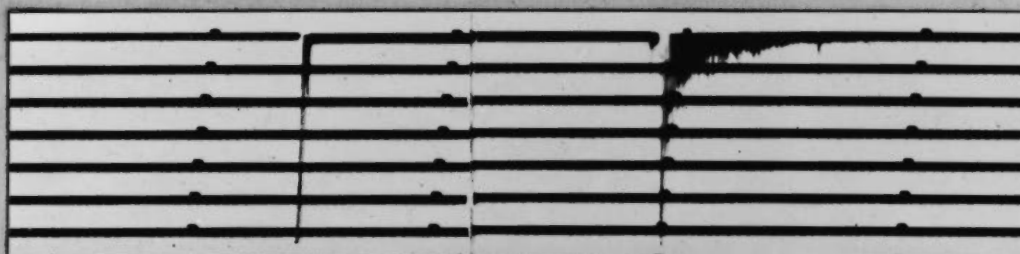
Sec. 8 and that for the latter going down the manway from the 4200' level at Sec. 5.8. The other set alternately served H25 and H28 in 4201W7. All holes were in the south, or hanging, wall and each was 30' deep, except H25 which was 100'.

The seventh geophone was placed in H26. (see Report No. 10) in 4201W9 and was arranged for listening only. A mistake in drilling holes 30 and 31 gave rise to some delay in getting records from 3925' level (H31). Otherwise, except for occasional time-switch trouble, the program ran without interruption through January to the time of a large crush burst which occurred on January 29.

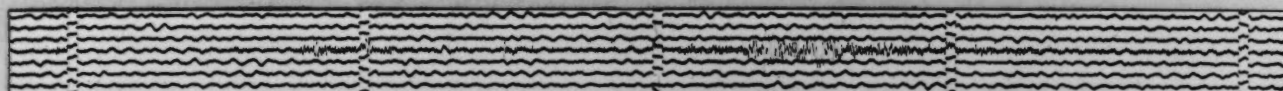
II. The Bursts of January 29 and March 31: At 2-12 a.m., E.W.T., January 29, a heavy crush burst occurred in the exact section under investigation. Fortunately, no one was injured. The levels from 3825 to 4325 inclusive were affected. The drifts were more or less completely closed from, approximately, the line of section 6 westward. The levels 3825 and 4200 (see Figs. 3 and 7) were completely blocked; 3901W (see Fig. 4) was badly shattered. It was possible, however, within a few days, to get through on the south drift, 3908W (see Fig. 5). The timber was badly shattered in 4001W (see Fig. 6), and the drift was blocked for a short distance at the line of Sec. 6, but was opened without too much difficulty or delay. The flat back over 4301W7 collapsed completely, and some damage was done in the drift, but the latter was soon cleared. Fig. 7 shows recovery work being done in 4201W6, using temporary timbering and steel piles.

The effects of the burst on the instrumental equipment were disastrous. As outlined in Report No. 10, the section of the west pillar under investigation had been specially wired with heavy BXL cable for geophone lines and style B wire for testing tappers. Practically all this wiring was destroyed. Every geophone was lost. The Obert set on 3801W9 was buried and has not been recovered. The doghouse on 4201W6 was badly shaken up but the instruments were not damaged. The program was left with two recorders, no geophones, and no cable.

As quickly as possible, the doghouse on 4201W6 was put into shape again and a hole 52' deep, H32 (see Appendix I), was drilled in the south wall just west of it. This was not drilled at right angles to the wall but with a strong westward tendency which brought the inner end of it



Kirkland Lake Seismogram



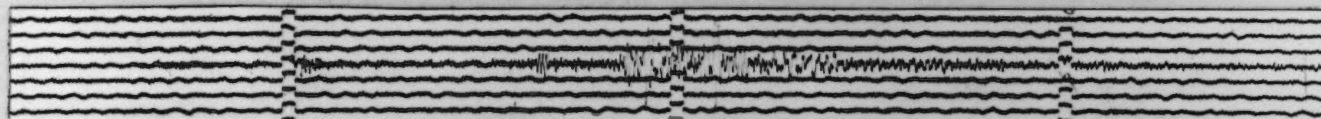
Ottawa Seismogram

Rockburst of January 29, 1943

Fig. 1



Kirkland Lake Seismogram



Ottawa Seismogram

Rockburst of March 31, 1943

Fig. 2

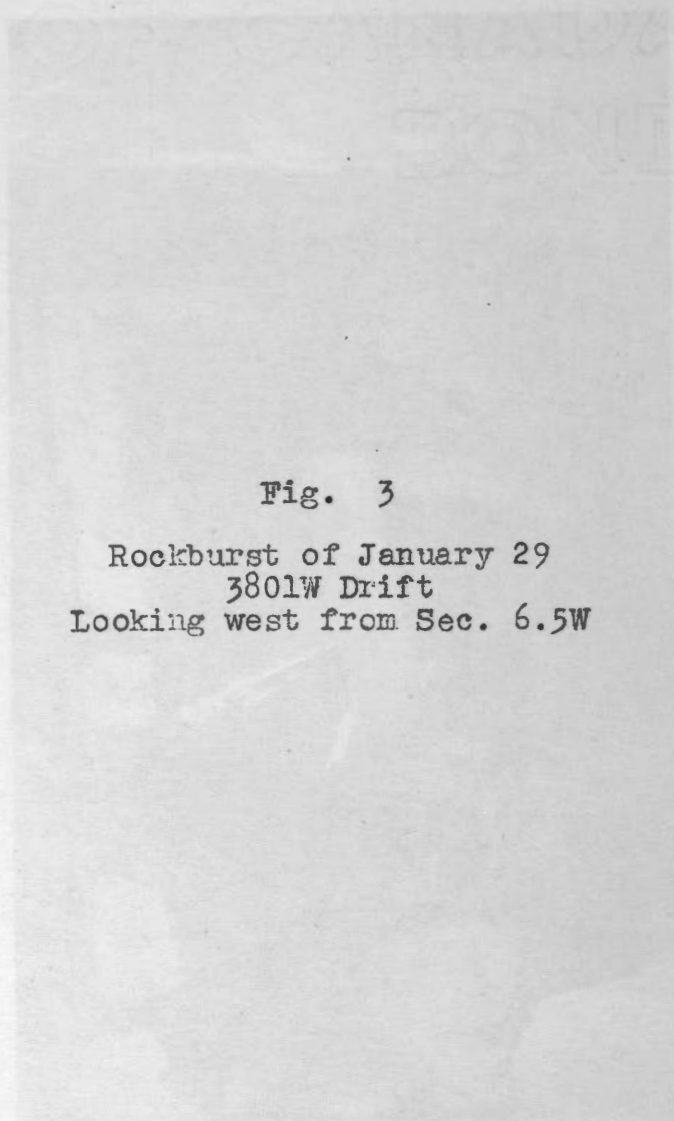


Fig. 3

Rockburst of January 29
3801W Drift
Looking west from Sec. 6.5W

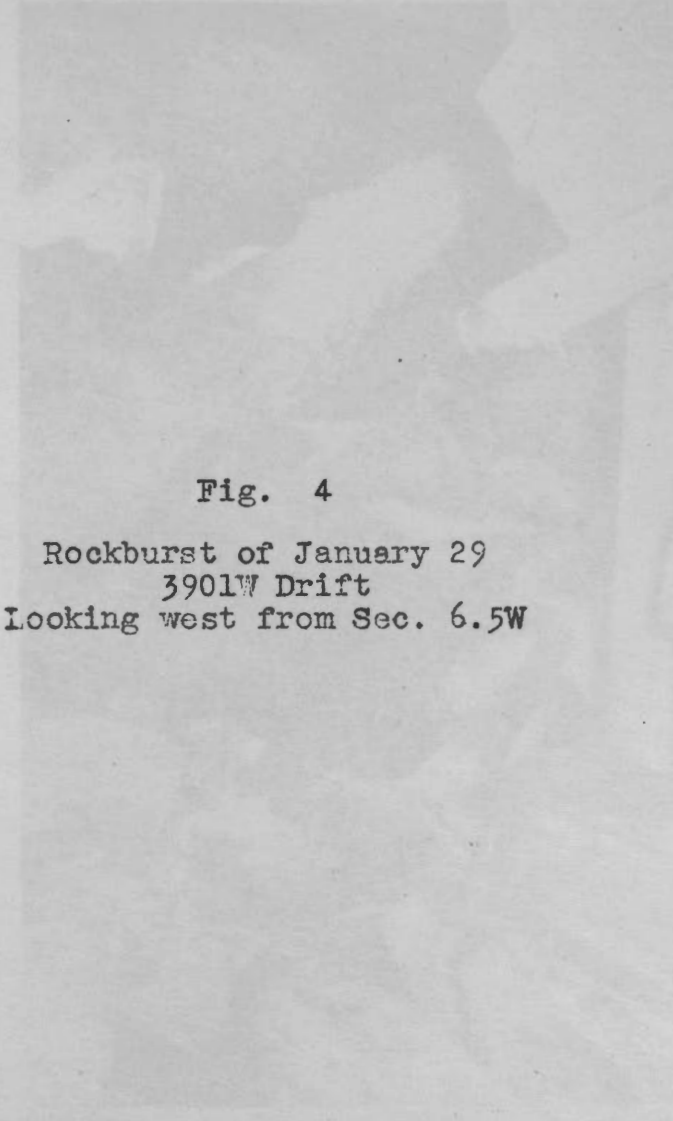


Fig. 4

Rockburst of January 29
3901W Drift
Looking west from Sec. 6.5W



Fig. 5

Rockburst of January 29
3908W Drift
Looking west from Sec. 7W

Fig. 6

Rockburst of January 29
4001W Drift
Looking west from Sec. 6.7W

Fig. 7

Rockburst of January 29
4201W Drift
Recovery Operations
Looking west from Sec. 6W



well inside the pillar some distance west of the blocked point in the drift. Recording began here on Feb. 13. The delay was due largely to the fact that new geophones had to be made. Fortunately, the crystals and transformers, then many months on order, arrived just in time to make this possible.

Another doghouse was built on 3801W, at about Sec. 6, immediately east of the point at which the drift was blocked. A hole (H33) was drilled in the south wall close to the blocked point of the drift and bearing strongly to the west so as to get as far into the pillar as possible. This hole was 53' deep.

One of the recovered Obert sets served on 4201W6, the other was installed in 3801W6. When 3908W was cleared, it was found that H31 was not damaged and geophone No. 1 was recovered from it. The BXI down the manway from the 3800' to the 3925' level was tested and found intact. Its drift sections were replaced and H31 was connected to the set in the new doghouse on 3801W6. Recording from H31 and H33 began on March 2, with some delay due to time switch trouble which was finally cleared on March 6.

The program from H31, H32, and H33 ran without interruption during the rest of March with no great activity showing at any time, either on the recorders or during listening tests. Then, on March 31, at 2-41 a.m. E.W.T., another crush burst occurred which affected the levels 3200 to 3950 in the west pillar. Again, fortunately, no one was injured. The sections of 3801W and 3901W which had been cleared after the burst of January 29 were again completely blocked. No damage was sustained by the equipment on 4201W6 but the new doghouse on 3801W6 was badly shaken up. The entire set was thrown from the bench to the floor but was not damaged. Holes 31 and 33 were lost, together with the geophones and cables.

After a survey of the damage, the mine decided, due to the scarcity of manpower, to abandon, for the duration, the mining operations in the west pillar from 3300 to 4200 inclusive, except between 3950 and 4075. The seismic investigations in that part of the mine must now be discontinued. Steps are being taken to locate on the east side. Some work may also be done both in the upper and the lower levels of the west pillar. A listening program must be undertaken to locate the most suitable locale.

III. Records of the Bursts of January 29 and March 31: These were both multiple bursts as can be noted from the Kirkland Lake seismograph records shown in Figs. 1 and 2. The first and second sections (89 seconds apart) of the January burst were recorded in overlapping fashion on the Ottawa seismogram. Note from the Kirkland Lake record that the second section was much the larger. Only the large, first, burst of March 31 recorded, so the phases are very sharply marked on the Ottawa record. The seismograms can both be used in a further study of elastic wave propagation but that for the March burst will be especially valuable. A comparison of these records with those given in Report No. 8 will serve to show how well the phases are defined and how exactly they follow the time pattern of the earlier bursts.

IV. Analysis of the Records: Early in January, it was realized that the record analysis suggested by Dr. Obert (see first paragraph, page 9, Report No. 10) would prove too much for the small staff of the survey. Accordingly, Mrs. Ethel Grace was appointed as clerical assistant. She began work on January 13. At that time, the records for the earlier part of January had not yet been read and the records then being obtained were very difficult to count because of the increasing activity on the 3825' and 3950' levels. Three records, each 30' long, were coming up each day, some having counts as high as 40 snaps a minute. The discovery, her first Monday morning, that the records (for the week end) were 60' long (!) almost made it necessary to engage a new assistant. To count the offsets in the nine categories suggested by Obert presented a formidable task. Some equipment was obviously required.

An emergency wooden comparator was built by Gibbs and served well until a metal one could be constructed. The latter, designed by Hodgson, was modified and improved by several with whom it was discussed but chiefly by Mr. Bird who built it in the Observatory machine shop at Ottawa. The base plate is a very heavy iron casting, which insures rigidity and permanent alignment of the various sections. It seems needless to go into details in this report. The comparator is shown in Figs. 11, 12. It provides a means of rapidly and conveniently handling the records, of analyzing and tabulating the counts and of noting the times and nature of coincidences between the records, and reduces the time scale from record to comparator sheet by a factor 1/2. Adjustments are provided to care for parallax between the recording styli of a set and for synchronizing of the records.

As only three to five inches of record can be synchronized at any one time with an accuracy suitable for noting coincidences (due to the slightly different rates of travel of the recording paper), only five inches of each of the three records are simultaneously exposed. It was found necessary to compare longer sections to permit annotating the records for time and synchronization marks. Accordingly, the annotator shown in Fig. 10 was similarly designed and built at Ottawa. This permits rapid, convenient handling of the records and exposes 15" or more of each of the three records at once. These two machines have greatly assisted in the analysis of the records. Counting has been done with the aid of a Veeder tally; and, when the record was very active, the use of a small hand magnifier. See for example the section of record in the upper left hand corner of Fig. 10.

The nine categories suggested by Obert considered the offsets in the groups: large, medium, or small (3, 2, 1) on the fast stylus, and large, medium, or small (3, 2, 1) on the slow. Thus one could have the nine groups: 33, 32, 31; 23, 22, 21; 13, 12, 11. It was at once found to be too great a task to so analyse the offsets. Coincidences were registered on the comparator sheets so as to show this complete analysis and also their distribution in time, but the counts were made only on the basis of the fast stylus offsets, as large, medium, small. These were counted for each two minutes of record for a total time, usually of 16 min. The counts were entered on the comparator forms where they were individually totalled and divided by the number of minutes used in the count. The averages of each category per minute were then added to find the total count average per minute.

The counts were tabulated for the entire period January - March, after the manner shown in Appendix II. It may be noted that the number of comparator sheets used for the complete period was 1017. Only the data for January are listed in Appendix II since the data for February and March were found to be too scanty to permit any deductions with regard to the burst of March 31, which originated probably on the 3325' level, 500' away from the nearest geophone.

It seemed worth while to mimeograph the January analysis for the use of the staff; and, that being so, it was considered worth while to include it as an appendix to this report. Record page and comparator page references in the table are of use only to the staff. The section of the west pillar which burst on January 29 (3825'-4325'

FIGURES 8 and 9

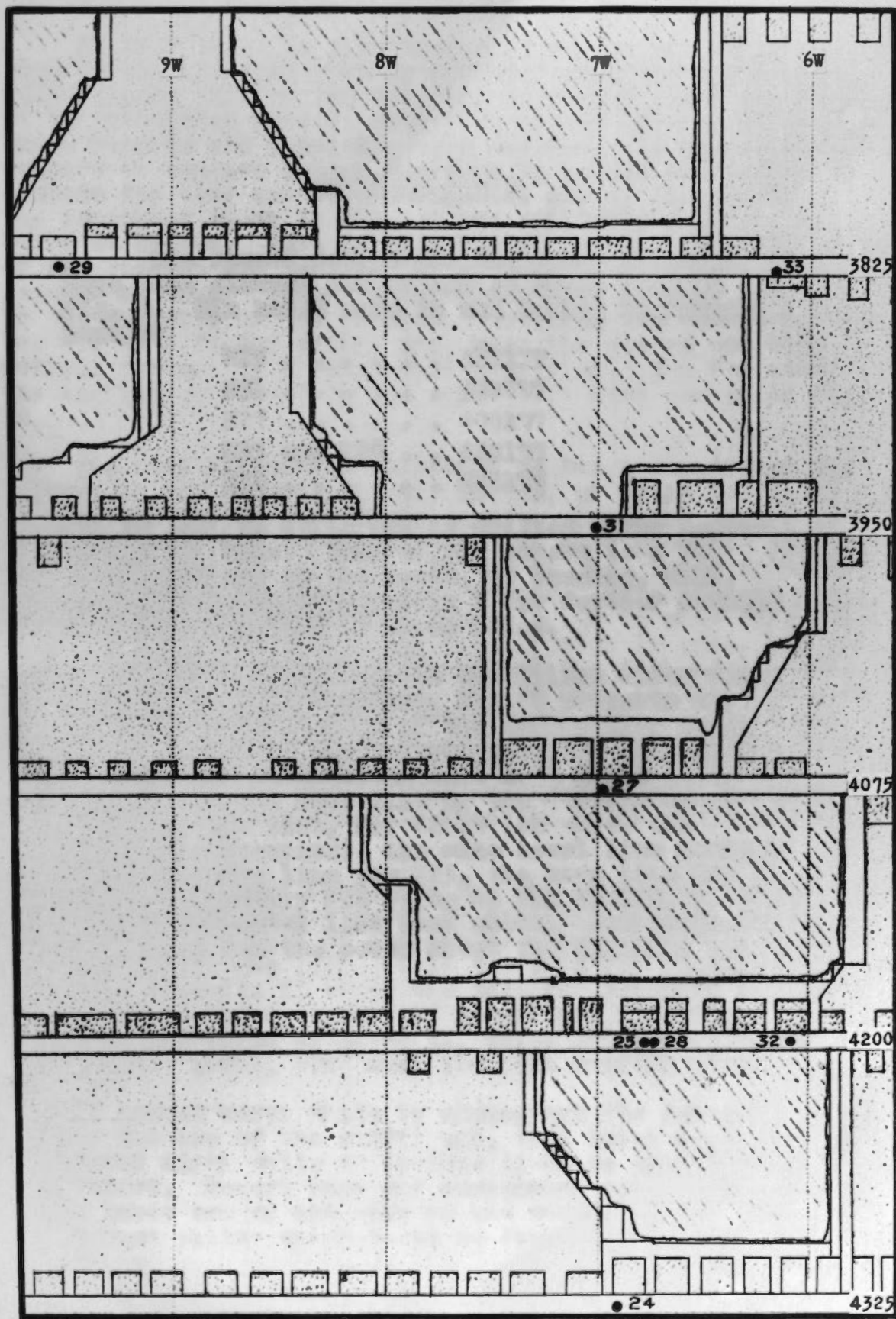
The record counts for the month of January have been plotted and appear in graph form in Fig. 9. Six holes were in use during the month, namely:

H29	3801W9
H31	3908W7
H27	4001W7
H25 and H28 . .	4201W7
H24	4301W7

H25 is 100' in depth and is drilled close beside H28, a 30' hole. Each of the others is a 30' hole. All are in the south, or hanging, wall. See the diagram of Appendix I for further details as to the location of these holes.

*

To assist in picturing the conditions under which the records were obtained, Fig. 8 presents an elevation of that part of the west pillar which is the locale of the investigations. The scale has been chosen to bring each mine level immediately over the zero line of the corresponding graph, except that, for 4201W (on which two holes were occupied), the mine level line meets the graph zero line for H25, the zero line for the supplementary H28 being at the midway, heavy, horizontal line next above. For scale dimensions see the cover sheet for Appendix I.



JAN. 1

6

11

16

21

26

31

90

80

70

60

50

40

30

20

H 29

3825

90

80

70

60

50

40

30

20

H 31

3950

90

80

70

60

50

40

30

20

H 27

4075

40

30

20

H 28

4200

40

30

20

H 25

4200

90

80

70

60

50

40

30

20

H 24

4325

JAN. 1

6

11

16

21

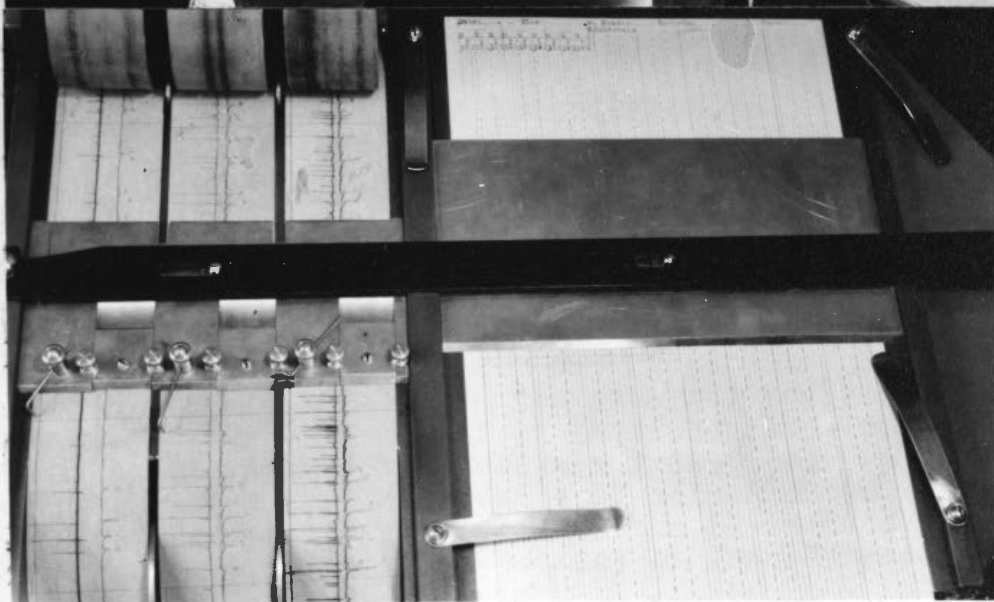
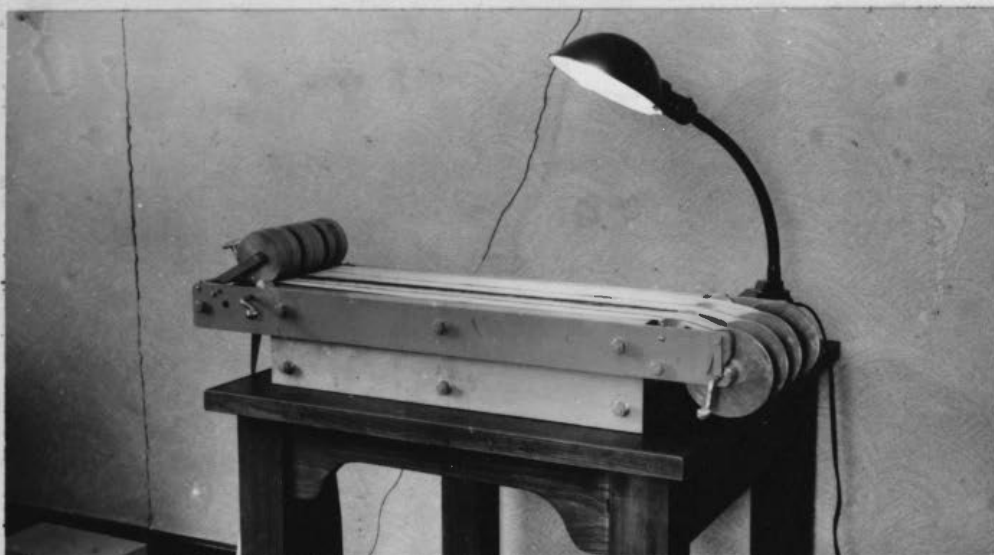
26

31

Fig. 10
Annotator

Fig. 11
Comparator

Fig. 12
Table of Comparator



levels) was covered as completely as possible by the equipment available. The records, made up into book form and paginated, together with the numbered comparator sheets, are indexed by the analysis. The whole forms the first basic reference obtained in Lake Shore Mine. The magnitude of the burst concerned is unique in a seismic survey of this kind. It is desirable to have these data ready for further examination in the light of later experience. It is, of course, not planned to continue such an elaborate system indefinitely, as the following sections of this report will indicate.

An examination of the data of Appendix II will serve to show that the counts varied from period to period (alternate half hours from 4^h-7^h and from 16^h-19^h). Little or no night shift mining was done in January in the part of the pillar being studied. Blasting was thus, in general, only from 14^h-15^h. The p.m. counts might be expected to be higher since they occur soon after blasting but this is not always the case as appears in Fig. 9 and as is noted in Sec. VII. It seemed best to average the p.m. and a.m. counts separately and plot the values obtained. This was done; the graph is presented as Fig. 9. To enable the reader not familiar with the mine to visualize the setting, an elevation of the mine to a special scale is superposed as Fig. 8. The scales of the elevation and of the graph are designed to bring each level of the elevation immediately above the zero line of the graph for the counts on that level. The only exception is for the supplementary H28 on 4200 which is plotted with its zero on the heavy horizontal grid line next above that for H25, which coincides with the 4200' level in the elevation. The graph of Fig. 9 will be discussed in Section VII.

V. Shifting Pressures: It has long been known that the pressures in the mine shift from point to point in the pillar, sometimes due to the progress of mining operations, sometimes due to bursts, and sometimes when none of these seems to have been the cause. A well recorded example of this is seen in the series of records shown in Fig. 13.

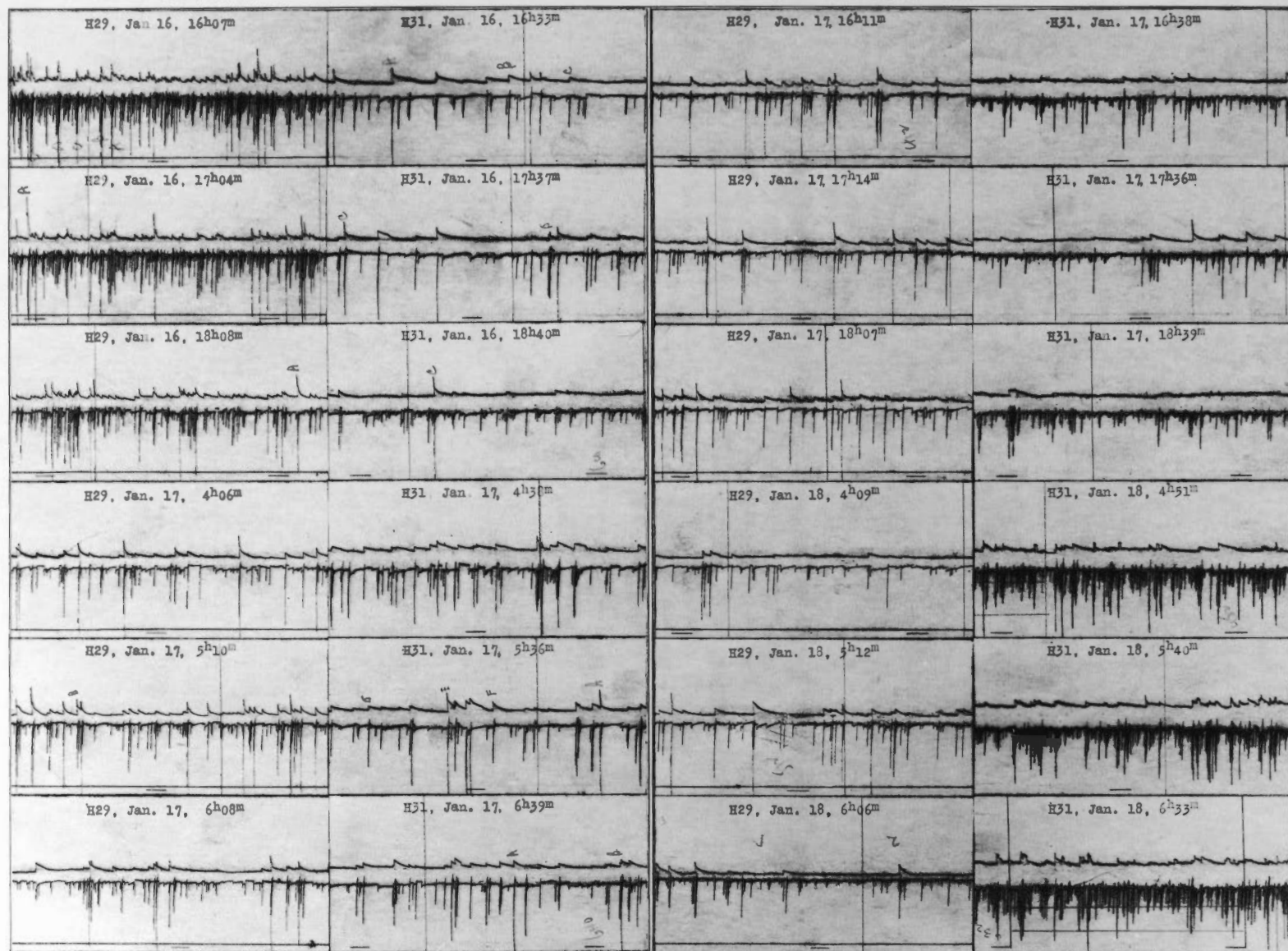
On the 3825' level, H29 (3801W9) recorded on Obert set 111 in the doghouse on 3801W6 for the first half of each of the hours (4^h-7^h and 16^h-19^h). The same set recorded from H31 on 3908W7 for the last half of these hours. There are, therefore, no simultaneous recordings from these two geophones; but, except for the absence of coincidences, this does not greatly matter. Sections of the 12 records from H29 are set side-by-side with sections of the 12 records

FIGURE 13

Activity on 3801W and 3908W
Jan. 16-18, 1943

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The records for H29 (3801W9) were made on set 111 (geophone 5) at 7.5 Db. attenuation. Those for H31 (3908W7) were made on set 111 (geophone 1) at 7.5 Db. attenuation. The hook-up to each geophone ran for alternate half hours, from 4^h-7^h E.W.T., a.m., and p.m. Each section of record shown covers 2^m40^s in time, spaced evenly about the time typed on the section. Note the extra line at the bottom of H29 records. This is the identifying trace to which reference is made in Part B, page 3, first two sentences of paragraph 2.



from H31 taken a half hour later in each case. Each section shows 2^m40^s of record. The period covered was January 16-18. January 17 was Sunday, when no work was being done in the mine.

For the part of the pillar being studied, blasting was over about an hour before the first record section, shown in the upper left hand corner, and mining was resumed shortly after the last record section, shown in the lower right hand corner. It is clear that, during the period of a week end, the pressure gradually passed from the vicinity of H29 to the vicinity of H31. Moreover, although these holes are only slightly over 250' apart, the activity at one does not record on the other. Finally, it is to be noted that there was no mining activity during the time of the pressure shift.

Evidently, the pressure at H29 on Jan. 16 and that at H31 on Jan. 18 was dangerously high. The records were so interpreted by the mine officials on Monday morning, Jan. 18, and steps taken to protect the miners until the records showed a lessening of the pressure as can be seen in the graph of Fig. 9.

VI. Salvos and Bursts: On July 25, 1942, a burst occurred in 4201W10. The only records prior to this were obtained for a few days from a hole in 4201W9. These records showed several runs of closely packed offsets. After the burst, no more of these were noticed until late in December, when both Hallick and Hodgson heard what, for a better name, were dubbed "salvos", during the listening period. These increased in number and, during January, were very numerous both in the upper and lower levels of the section of pillar being investigated. They could never be heard except with the amplifiers. Occasionally each of the operators has heard these salvos and, at the same time, seen them record. It seems certain that the disturbances are seismic.

At other times, a single sharp snap can be heard with the unaided ear; but the recorder, after registering the initial sharp offset, continues to record snaps for some time. These disturbances are spoken of as bursts, though, except for the initial snap, nothing can be heard with the unaided ear, no damage is done, and they do not register on the surface seismograph.

Both types of disturbance are extremely local. Sometimes there is a marked difference between the records of H25 and H28 which are holes side-by-side in 4201W7, the

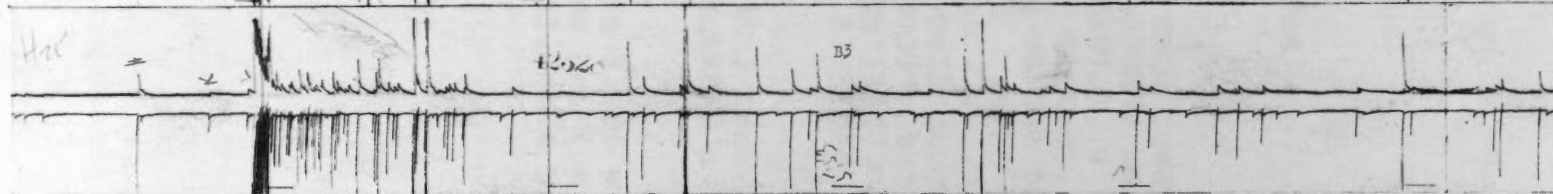
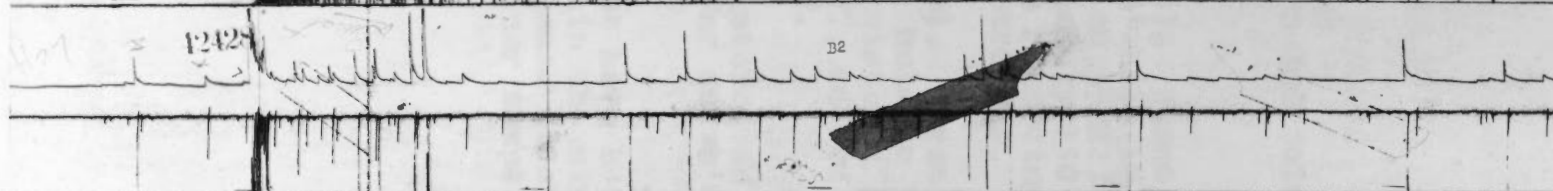
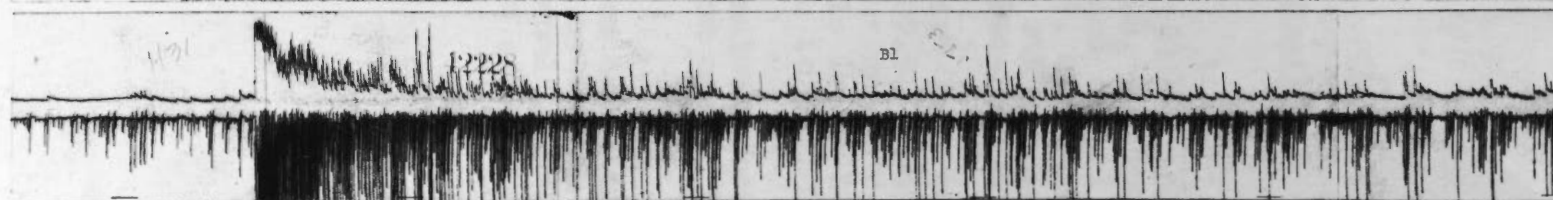
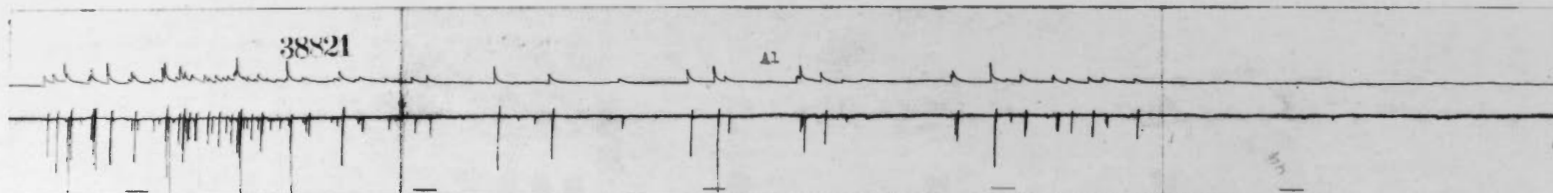
FIGURE 14

Sample Records of Small Bursts and Salvos

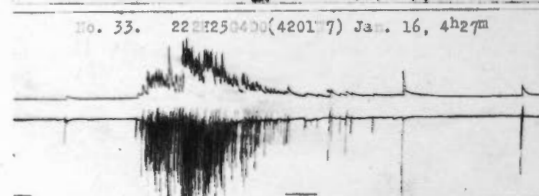
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- A. Jan. 14, 4^h33^m (No. 26). Burst well recorded on 222H25G4D0, the 100' hole in 4201W7 and hardly recorded at all on 333H27G6D7.5, a 30' hole in 4001W7, approximately 150' distant. H31, the only other hole recording at the time, was having time-switch trouble.
- B. Jan. 28, 5^h49^m (No. 59). Burst well recorded on 111H31G1D7.5, a 30' hole in 3908W, but only the larger snaps registered on 333H27G6D7.5, a 30' hole in 4001W7, and on 222H25G4D0, the 100' hole in 4201W7.
- C. Samples of salvos registered on the hook-up indicated on each. For salvo details see Appendix III.

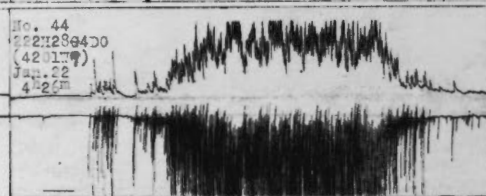
NOTE: The salvos could not have been heard with the unaided ear by anyone in the mine and the bursts so-called, would, if heard at all, have probably sounded like single minor snaps.



No. 33. 222H2504D0(420177) Jan. 16, 4h27m



No. 44
222H2894D0
(420177)
Jan. 22
4h22m



No. 52

222H2804D0(420177)
Jan. 26, 4h12m



former 100' deep and the latter 30'. Often they do not record fully on a geophone in the level next to that on which they register as a maximum. Sometimes, when occurring in the deep hole H25, they will register at H29 in 3801W9 but not at H27 in 4001W7, only one level away.

It is thought that the occurrence of these salvos and small bursts in a section of pillar indicate overall pressure conditions approaching a critical value. One explanation advanced for their recording on H29, but not on H27 or H24, at the same time as on H25 is as follows: It is known, as stated in Report No. 10, that slight disturbances do not readily traverse a discontinuity (fault, break or vein). If the walls of the pillar are laminated (onion skin pattern) with the supports for the deep-lying arch on the heavy pillars above 3700 and below 4325, then a disturbance originating in this deep-lying arch, penetrated by H25, the 100' hole, would not readily break through to the inner laminations to record on H27 (4001W7). There are other evidences of this segregation of disturbances into arches. For example, note from Fig. 9, how more nearly the graph for H25 reflects H31 than it reflects H27 or H24.

To permit a further study of these salvos and bursts, they have been tabulated, largely for the convenience of the staff. The tabulation is given as Appendix III. It is to be noted that 61 of these registered in January during recording periods which cover less than 8 percent of the elapsed time. Reference to page numbers of the records, of no use to the general reader, permit the operator to refer to the record at once, if and when some theory or suggestion requires examination in the light of observational data. Examples of both salvos and bursts are shown in Fig. 14.

VII. The Graph of Record Counts for January: The points for this graph were obtained from the record analysis of Appendix II, by taking separately the averages for large, medium, small, and total snaps for all p.m. and all a.m. observation periods, respectively, for each day. As plotted, the upper line shows the totals, the next the small, the third the medium, and the bottom the large snaps. The first ordinate after the date line shows the a.m. average, the second the p.m. average. Any question arising as to irregularities or breaks in the graph, not explained in the text of the report, can be answered by reference to Appendix II.

It is to be noted that H29 was very close to a working

stope, but that no other of the holes was nearer than 50' or more. This is especially interesting when the relative counts for p.m. and a.m. times on each day are considered. On the 3825' level, the p.m. counts (right after blasting, which occur from 2^h to 3^h p.m. for these levels) are higher, as a rule, than the a.m. counts for the same day. All the high peaks are p.m. But, on the 3950' level the reverse is the case. All a.m. peaks are higher than those for the corresponding p.m. times. For the lower levels there does not seem to be the same uniformity. It is to be noted that the high count for H31 on the a.m. of the 12th and on the a.m. of the 18th are reflected on all levels except 3825. No night shift work was done during January on or below the 4075' level and the only work done above was by a reduced shift.

It is likely that the counts on H29 are unduly affected by mining operations, as this hole was less than 25' from a working stope which was close to breaking through to the 3825' level from below.

It is interesting to trace a curve through the a.m. points and another through the p.m. points for H31. Each rises toward the date of the burst. On the other hand, those for H29 consistently flatten out toward January 29.

The large counts (lowest of the graph lines) clearly are not very informative nor, in general, are the medium ones. The smalls are the best of the three; but there seems no valid reason, in the light of these graphs, for counting anything but the totals. The large and medium snaps should be noted for coincidences, but to count them separately seems a waste of time. Note the importance of recording small snaps.

It is evident that a total count of 100 snaps per minute indicates dangerous conditions; but, in this all-too-short set of data, there are three peaks of nearly or greater than 100 without a collapse. It is unfortunate that no records were obtained after 6 p.m. on Jan. 28, 8 hours prior to the burst. It is also to be regretted that the record for H29 and H31 for Jan. 28-29 was lost with the recorder and cannot now be recovered.

The sharpness of the peaks is remarkable. If pressures build up and fall at this rate, it is evidently necessary to record 24 hrs. a day, or at least for short periods at close intervals for the whole day, so that the records do not stop 8-10 hrs. before a burst. In Sec. VIII recommendations will be made in this connection.

The fact that the peaks for H29 do not coincide with those for H31, though the holes are only about 250' apart, shows clearly that critical pressure is quite local and that the record reflects conditions within only a short distance, probably 50'-100', from the geophone. Certainly, the pillar was not sufficiently covered with geophones, though that was the fault of no one, for the fact had been recognized and every effort was being made to obtain the necessary crystals and transformers for making more geophones. All seven available geophones were in service and were distributed as evenly as possible over the suspect section of the pillar. It was fortunate that the earlier attempts to obtain crystals and transformers had been made, for these arrived only just in time to permit the construction of new geophones after all those on hand had been lost in the burst of January 29.

It is interesting to note that the 100' hole (H25) is not much more informative than the adjacent 30' hole (H28); but it is most unfortunate that, at the time when the comparison would have been best, January 15-18, no records were obtained from H28. This was due to the fact that the time-switch on 3801W9 was giving trouble. It was taken to surface for repairs and the switch handling H25 and H28 was taken to 3801W9 till the faulty switch could be returned. While this arrangement was in force only H25 recorded on 4201W.

From a consideration of the Kirkland Lake record (Fig. 1) and the graphs of Fig. 9, it seems evident that the first (smaller) burst of January 29 occurred on the 3950' and/or the 3825' levels, and that this initial burst allowed pressure to fall on 4200, raising it above the critical value and resulting in the general burst. During the fall of 1942, the conditions on 4200 had several times been considered critical while the upper levels, 3825' and 3950', were quiet. When, in January, the upper levels became critical, the counts on the lower levels fell, due, no doubt, to the temporary relief afforded by the pressure taking up in the higher levels.

Evidently, in an extensive pillar such as the one here studied, it is necessary to have long term observations over as much of the pillar as possible. If pressure gradually passes from a point A, to appear at B, some distance above or below, it must not be forgotten that the load is still poised with respect to A and that a burst B will probably result in another at A.

III. Deductions and Recommendations: It becomes increasingly evident that critical pressures are very limited in extent,

that they build up and decrease quite rapidly, and that geophones reflect the conditions as critical only when within about 50'. Moreover, long-term, wide-area observations must be made to learn what points in the locale under observation, within 500' or so of a region now critical, have been under severe pressure some weeks or months previously with no relief from a burst. Recording should evidently be done continuously or at frequent intervals throughout the entire 24 hrs., so that the entire diurnal variation in activity can be known. Many holes must be used, to be serviced first by an intensive listening program to locate critical regions, and then by a close network of geophones and recorders. Recorders are expensive and almost irreplaceable. They must, as far as possible, be kept well in the fill. It must be possible to install them, at will, in any of the drifts under observation. Geophones are almost certain to be lost in a burst. They are inexpensive and can be obtained by making an effort to secure the necessary priorities and then waiting for the crystals and transformers.

It is therefore recommended that:

- (1) At least 100 crystals and 50 transformers be ordered at once and steps taken to push through the priorities and get the orders into the hands of the companies concerned. In the meantime, the necessary casings should be made in preparation for a time when many geophones will be simultaneously required.
- (2) Holes 30' deep be drilled as soon as possible at regular intervals of about 100' in the hanging wall in each drift to be studied. This, at the moment, indicates the west pillar on the 3200' level and in both drifts on the east side from the 4700' level up and/or down as far as the critical conditions are suspected.
- (3) One geophone be placed in the hole nearest the centre of the pillar on each drift to be studied, and left there for use in the listening program to give one control point in each drift at which irregularities due to a different placing of a portable geophone could receive some check. These geophones should be included in the regular underground testing program.
- (4) A regular daily listening program be begun at once using the light-weight portable outfit now being

constructed. At least three levels should be completely covered every day. Three or four minutes listening at each hole would suffice for this reconnaissance survey. The readings should be tabulated and plotted regularly each day.

- (5) Two portable instrument boxes of wood be designed and built on surface, something like a large tool box with projecting handles or carrying bars. These should be designed to house closely the three units of an Obert set with all normal auxiliary equipment. They should be wired for lights and outlets and have an external input socket into which the A.C. supply could be plugged. These boxes should have hinged covers, which, on being opened out, would give ready access to the recorders and provide a bench top for working.
- (6) In each level to be studied an observing site be selected, certainly well within the fill section on the side of the pillar toward the crosscut, and preferably against the foot wall. At each site, a pair of I-shaped pipe trestles should be set with one end of each set in a hole in the wall and the other firmly placed on the floor of the drift. These would provide a support for the portable instrument box. Above each site heavy new lagging or timbering should be placed to enable the operators to work without hats in front of the instruments. To each site A.C. should be wired, terminating in a plug for connecting to the instrument box.
- (7) For the time being, the set up on 3200W, that on 4201W and that on 4700E be the only installations to be operated regularly and that for the time being, until better arrangements can be made, the records be run every alternate 15 min. throughout the 24 hrs., if, in Mr. Gibbs opinion, this is not likely to injure the recorders.
- (8) As soon as the listening program discloses a critical region, the portable instrument box be taken at once to the drift concerned and at least two geophones be connected to it to record every alternate 15 min. for the 24 hrs.
- (9) As soon as possible, the micro-switches having already

arrived, time switches be made to enable four geophones to record, two and two, for alternate 15 min. on each new Obert set.

- (10) If, at all possible, large scale elevations of each drift of the east side, similar to the one made for the west pillar, should be drawn for the use of the survey.
- (11) For all recording, the counts should be restricted to totals only and the coincidences noted only in large and small categories. All records should be carefully studied, counted, tabulated, plotted, and booked each day as received. Routine testing of all equipment, including the control geophones for listening, should be carried forward on a regular program.
- (12) Some means should be found of implementing recommendation No. 16 of Report No. 10. It is obvious that the progress of mining has a distinct bearing on the building up and movements of critical pressures. Some simple arrangement should be made, whereby the survey engineers can, as a matter of routine, note the mining which has gone on each day in the section under survey and plot the information in some symbolic manner on the record graphs.

Dominion Observatory, Ottawa,
May 10, 1943.

E. A. H.

Report No. 11

Part B

Instrument Development

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Zack E. Gibbs

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SEISMIC RESEARCH PROGRAM
ROCK BURST PROBLEM
LAKE SHORE MINES

Report No. 11. January - March, 1943

Part B. Instrument Development

Zack E. Gibbs

After a year's experience with subaudible vibration recording instruments at Lake Shore Mines, it seems worth while to enumerate some of the work done in servicing and repairing these instruments and in manufacturing associated parts and apparatus.

Geophones first were constructed after the pattern of Dr. Obert's geophones, using brass pipe for cases and brass for crystal mounting tables. To save time, special taps and jigs were made with which to machine these geophone parts. Originally, a transformer was placed at the collar of each drill hole used, to properly couple the high-impedance rochelle salt crystal into the low-impedance, transmission line, to the recorder. Later, when they were available, very small coupling transformers were installed within the geophone cases themselves. The geophone case was made originally with a packing gland to pass shielded cable into the case and maintain a watertight joint, but this system was abandoned. An amphenol connector was mounted on the geophone case enabling the geophone to be detached from its cable. This facilitates carrying and permits longer cables to be attached. The diameter of drill holes is such that a cable connector can not be used within a hole except at the geophone. The bulk of a connector prevents the passage of the loading poles.

In the first geophones constructed, the rochelle salt crystal was mounted by wedging it with mica into a slot cut in a brass post. They were then firmly cemented in place with Duco cement. Later, instead of the mica wedge method, a larger slot was cut in the support post, and a brass plate clamped against the crystal with small machine screws. This provided a much better support.

A new type of mounting was devised by Obert and incorporated in geophones delivered in March, 1943. In these, a small steel plate was clamped across the end of the crystal, making a much simpler and more rugged support than any before used. Twelve geophones with cases made of steel pipe were

made at Lake Shore to replace those lost in the rock burst of January 29th, 1943. A supply of crystals and transformers, previously ordered, were delivered in time for the assembly of these geophones.

Originally, geophones were loaded into holes with an unwieldy, plumber's "snake". This is still used in very deep holes, but for holes up to 30' in depth a special set of loading poles was developed. These poles are made of 6' lengths of $3/8$ " pipe. In one end of each section is fastened a steel pin $7/16$ " in diameter, projecting 2". Through this, 1" from the end, is drilled and tapped a hole for a 1/4-20 screw. The opposite end of each rod is drilled and reamed $7/16$ " in diameter; and, 1" from the end, two holes are drilled on the diameter. One of these is $5/16$ ", the other is $3/16$ " in diameter. In use, the pin of one pole is inserted into the hole in the next and the three diametral holes lined up. Through them is then screwed a special 1/4-20 screw which effectively joins the two. On the entering end of the poles, is welded a cylinder of 1" pipe in which a $3/8$ " slot has been cut parallel to the axis. This cylinder pushes against the rear end of the geophone without disturbing the amphenol connector of the geophone cable which has been slipped through the slot. When the geophone is in place the poles are removed.

When the program of underground recording was first put into operation, it was evident that some means must be devised for turning the recorders on and off. Consequently telechron "Organizer" clocks were obtained. These were designed for use in controlling home radios in accordance with a pre-arranged schedule. Since they automatically "cleared" themselves after a program was finished, changes had to be made in the internal construction in order that they would repeat every twelve hours whatever schedule had been set up. These clocks have given very good service. The only objection to their use is the fact that the operation of the switch may vary by about a minute (\pm) at different settings. This makes it difficult to correlate records made at different locations in the mine.

To enable recorders to cover more than a single hole, it was decided to make up switches which, at regular intervals, would connect to an amplifier either one of two geophones. Inquiry disclosed that "Microswitches", ideally suitable for this work, were unobtainable without priority. Instead, construction was undertaken of double-pole, double-throw, switches of a toggle type actuated by a synchronous

clock mechanism. These were designed and three of them constructed. Again telechron clocks were called into service. This time a popular kitchen type was used. The face and hands were removed and a special spindle driven by the minute hand gear, was made to support a crank arm. This arm in turn was connected to the switch mechanism which was thrown each half hour.

Soon after being placed in service, it developed that some method of identifying which of the two geophones was connected at a given instant must be worked out. To this end an extra pair of contacts was placed on each switch so that when one pair of contacts was closed, an auxiliary circuit caused an extra writing stylus to make a continuous line on the edge of the record, as long as that particular geophone was connected. These clock switches have not been too satisfactory, due to the fact that while the toggle action is fast, the clock motion is slow. There is rather a long interval during which the contact pressure is lightened, allowing stray disturbing voltages to be impressed on the connecting cables. Plans are in progress to change the form of these switches, utilizing the better "Microswitches" which have recently been made available. Furthermore, the widening of the scope of the recording program makes it imperative that more than two and perhaps as many as six geophones be recorded on one recorder. This means more switches per clock.

A "stepping relay" was made up of a Yaxley, 11-point switch, housed in a heavy pipe case and turned step by step by a ratchet and pawl actuated by an electromagnet. The arrangement worked nicely in the laboratory and for the first few days underground. Failure was brought about by the absorption of moisture in the insulation of the relay wires which effectively short circuited the relay winding. Before other water proof wires could be installed, the listening program, for which this arrangement was made, was abandoned in order to launch the present recording program. There is no question that the stepping relay may be adapted to this new problem by allowing a clock, by means of a cam, to close the relay energizing contacts and actuate the stepping ratchet. Some improvement may also be made by the substitution of "Microswitches" for the wiping contacts.

Some means of easily changing from geophone to geophone while listening to the rock noises, was needed. To accomplish this, a switch-in device, bearing the designation LSM-13, was constructed. It consists of two double contact switches

arranged to connect any one of six geophones to either of the two amplifier channels which comprise LSM-11. A selection of geophones may instantly be made which enables one ear to listen to one geophone while the other ear listens to a geophone some distance away. In this manner, holes may be quickly compared for activity and simultaneity.

Simultaneous comparison of two recorders has been made possible by a device which effectively splits the signal from a single geophone and applies it to the input circuits of the two amplifiers to be compared. Electrically, this amounts to connecting the input transformers in parallel. The loss of sensitivity occasioned by this parallel connection has proved to be negligible. While originally intended for testing with a geophone under actual recording conditions, the input comparator has proven invaluable in laboratory testing. A test impulse oscillator is connected through the input comparator to the recorder under test and at the same time to a recorder known to be properly adjusted. Examination of the two records obtained gives a check, not only of the amplifier and recorder, but also of the validity of the output of the test impulse oscillator while the test is being made.

Several different high gain vacuum tube amplifiers have been built for the purpose of listening to subaudible vibrations in rock. Two requirements must be met in these instruments. First, high amplification and stability; and second, light weight and ease in carrying. To these primary requirements might also be added low battery drain. To enable the listening to begin immediately, a small battery powered amplifier originally made for other use, was rebuilt. A third tube was added to increase its gain. While this instrument known as LSM-10 was in use during the first months of the program, another larger and more powerful, dual amplifier, LSM-11 was built. This was a two channel system having a gain of about 10^6 . It required a storage battery to supply its filament voltage. Since they were available in stock, heavy duty "B" batteries were used. While the amplifier itself was of reasonable weight, the battery supply was unwieldy and so heavy that it was hardly portable without some sort of mine truck. To meet the need, a ball-bearing, light-weight truck was designed and built.

As soon as this LSM-11 was put into service, the smaller amplifier LSM-10 was rebuilt and a fourth tube added to bring its overall amplification to a value comparable with the larger unit. At the high gain attempted, the microphonic

characteristics of 1.4 volt tubes proved highly disturbing and it was difficult to prevent feedback oscillations. Other more pressing work interrupted the development of LSM-12 as this revised battery type was called. However, the listening program is now to be resumed and to this end another amplifier is being designed which will utilize 6.3 volt tubes. Filament voltage will be supplied by Edison storage cells available from the mine's lamp room. These will be recharged in the customary daily routine of the lamp room. Using these and a small size, commercially available, "B" battery, the entire amplifying apparatus will weigh about 10 1/2 lbs. and can thus be easily carried in a shoulder haversack. In this manner, many holes may be tested each day, the operator merely walking to the hole and inserting a geophone. Listening may be done without the necessity of removing the pack from his back.

In a program such as the one being carried out at the Lake Shore Mines, where the results obtained in one area, with one set of instruments is compared with results obtained in several other areas and with a number of different instruments, it becomes imperative, that some means of standardization be used to insure, first that the instruments are identical in their responses, and second, that they remain identical over long periods of time. Several methods were tried to establish the original identities. The results left much to be desired until recently when a Test Impulse Oscillator was built in accordance with design information furnished by Dr. Obert. This, combined with another dependent bridge circuit, which will be described later, is known as LSM-14. Its purpose is to apply a pulse of determined length and amplitude to the input terminals of a recorder amplifier upon depressing a switch. Adjustments are provided to vary the length of the pulse as well as its amplitude, while the frequency of the signal is fixed in the laboratory and unchangeable. After a standard pulse and amplitude is determined to be suitable, then all subsequent standardizing tests are made with the identical settings of the control knobs. Due to the circuit characteristics, once the cycle is begun by depressing the switch, the test is out of the hands of the operator. The uncertainty of personal reaction time is thus removed from the standardization procedure. This test impulse oscillator is small enough and light enough to be carried easily to the recording locations underground. Routine tests of recorder operation may thus be made without returning the apparatus to the surface.

As an example of the procedure followed, the oscillator is connected to the amplifier under test by a short length of shielded cable while its filaments are energized from the lighting power circuit, available at each recording station. With the driving motor of the recorder running, the main attenuator of the voltage amplifier is set at infinity. Beginning thus, a series of three or four test impulses are made in quick succession at each five-decibel, attenuation step, from 45 db. to zero. The pattern of the offsets recorded gives a clear indication of the adjustment and sensitivity of the amplifying and recording units. Any discrepancies indicate adjustments necessary. If these, when made, are without effect, defective tubes or other parts may be found.

While the Test Impulse Oscillator gives an excellent insight into the operation of the amplifier-recorder combination, it offers no check on the geophone itself. Since the geophone is the source of electrical impulses transduced from mechanical vibrations under observation, it is highly important that its response be uniform. To this end, a "Shaking Table" has been devised. Its driving element, made from a permanent magnet loudspeaker, vibrates the table in response to energy supplied to it from a master oscillator. The geophone under test placed on this table then drives its own voltage amplifier. To this amplifier a vacuum tube voltmeter is attached in place of the regular recording unit, and provides an accurately calibrated means of comparing the result of changes in frequency and/or amplitude. Since resonances in the table itself affect its amplitude of vibration even more than voltage changes, merely insuring constancy of applied voltage does not establish the amplitude of the vibration of the table. Therefore a form of condenser microphone is attached to the shaking table. The variable condenser has the property of supplying a voltage directly proportional to the change in separation of its plates. By connecting these plates to a cathode-ray oscilloscope or, if available, to another vacuum tube voltmeter, a means of standardizing or measuring the amplitude of the shaking table is obtained. In practice, the frequency of the master oscillator is chosen, and the shaking table amplitude is adjusted by changing the driving voltage until the output of the condenser microphone corresponds to a standard value. Finally, the output voltage of the voltage amplifier is measured, taking into account the attenuation, if any, introduced by its master attenuator. A graph of the output voltages versus input frequency (vibration amplitude remaining

constant) gives a true picture, not only of the sensitivity of the geophone, but also of its resonant frequency and the manner in which the output voltage depends upon frequency.

Since the method just outlined is far too laborious and complicated to be used as a routine test, and further since it is out of the question to take the bulky and valuable apparatus underground, an alternative, secondary routine test is now being devised. It is a known fact that if a capacity is connected to one pair of terminals of an ideal transformer, then the other pair of terminals exhibits a capacitive reactance which is a function of the original capacity and the impedance ratio of the transformer. Following this reasoning, tests were made of the capacitive reactance of the low-impedance side of the geophone transformers, the high-impedance sides being connected to the rochelle salt crystals. Values of capacitance from 1.4 to 3.4 microfarads were observed in geophones having good output sensitivity, while values in excess of 70 microfarads were noted in defective geophones. Capacity measurements on mounted crystals alone give values of the order of 0.003 microfarads. The larger values (due to the transformer impedance ratio of about 1600 to 1) are a decided advantage. Since the geophone cables have distributed capacity of approximately 3.5×10^{-5} microfarads per foot, small values of crystal capacity would be indiscernible at a distance. However, the magnitude of the cable capacity is small compared to the reflected capacity of the crystal as measured above and therefore does not seriously affect the accuracy of measurement of the larger value.

As was mentioned before, the test oscillator contains in its case a capacity bridge, which is supplied with alternating voltage at 500 c.p.s. from the impulse oscillator which, during these capacity measurements, is caused to run continuously. The null balance of the bridge is detected with a pair of earphones and values of capacity are read on a graduated dial. The method of operation hinges upon the measurement of capacity of each geophone and connecting cable, immediately after it is installed in its drill hole. This value is then entered in record notes along with data determined from laboratory test outlined previously. Capacity measurements can then be made weekly along with the routine test of recorders and will provide indication of gradual failure of any crystal, such as occurs when moisture is absorbed or, more abruptly, when a crystal is broken.

Provision is being made for an over-all "assurance"

test of each geophone and associated amplifier-recorder. A set of six "tappers" has been completed and awaits installation. A tapper is, what the name implies, a device which will tap the rock in the vicinity of a geophone in a uniformly repeatable manner. In this case, it takes the form of a small pendulum which is displaced from the vertical by a motor-driven cam and allowed to swing against a piece of steel rod set in the rock and supporting the device. A separate pair of wires is run to each geophone hole. Over these, 115 volt A.C. is sent to drive the telecron motor when a test is desired. Each time a record is started or finished, a test impulse is applied. This cannot be compared directly with any other geophone hole, for conditions of ground and steel will vary over a wide range. However, for a given hole, tests made daily should provide identical records if the entire system has undergone no change. The operator and computer are thus assured that the instrument is in working order. As soon as discrepancies are noted, steps can be taken to rectify any troubles which have developed.

Soon after the recorders were first installed underground, trouble began to develop with the writer coils. These would open circuit as though burned out. Replacement became a serious problem. Individual coil construction had to be abandoned and mass production methods substituted. Dies were made to cut coil forms and a winding jig built with which to apply the No. 40 wire to the forms. Nearly a hundred of these replacement coils were used, as the rate of failure reached a maximum of one a day. Study of damaged coils disclosed electrolytic action. The failure always occurred in the first or last few layers. Furthermore, under a magnifier, minute spots of corrosion were visible. In order to reduce the moisture content of the air surrounding these coils, 50 watt electric lamps were installed in each recorder box. The trouble ceased abruptly. Later inquiry disclosed that the failure was usual in similar apparatus operated under conditions of extreme humidity. Slightly acid pH conditions in the paper from which the coil forms were made, contributed an electrolyte which seeped through minute cracks in the wire's enamel insulation. The potential difference across the coil established current through the electrolyte which corroded the wire to the point of final failure. All new recorders of this type now have heaters installed. Specially prepared coils are also used, wound on neutral bakelite forms and impregnated with moisture-proof wax.

Occasionally the records were charred in places and

sections several inches long and up to half the width of the record burned away. No reason could be found at first. Several fires of more serious nature occurred, damaging the take-up rolls, feed rolls, and destroying entire records. Various means of preventing this were tried without success. A disastrous fire finally occurred in one unit which destroyed all insulation, rubber and lucite parts, burned the wooden case and rendered the recorder useless. Emergency repairs were made on this instrument and it was restored to service. Subsequent checking revealed that its frame was out of alignment. This was remedied and all the other recorders were checked and straightened. Apparently misalignment was due to rough handling in shipping. The skew of the paper rolls caused the record to ride up out of the platen guides. This in turn reduced the contact area between the paper and platen which caused arcing along the edges of the paper. Under extremely bad conditions this arcing, which usually only smoldered, actually burst into flame. Fireproof steel cases were built to replace the original wooden ones to confine future fires to the instrument itself and prevent possible spread to mine timbering. However, since the recorders have been aligned and paper travel improved, no more trouble has been experienced with burning of the records.

Line voltages underground are far from ideal for the operation of electronic apparatus. Seldom is the voltage over ninety volts. This has made necessary the installation of voltage correction transformers at each recording location to raise the supply voltage to approximately 110 volts at which point the automatic regulation devices incorporated in the amplifiers take care of any small fluctuations.

At some adjustments of high gain, the writer styli have been found to oscillate wildly without stimulus from the geophone. Searching for the trouble revealed that small changes of writing current occurring at the paper, caused large changes of voltage at the point from which this current was obtained in the power supply. Filter sections between this point and the plate circuit of the first high gain amplifier tube removed almost all of these fluctuations but the very small remainder was sufficient to feed back through the amplifier to continue the disturbance indefinitely. By applying a bypass condenser directly between the supply point and ground, across the current limiting resistors and writer point, the trouble was completely eliminated and much higher amplifications were made usable.

Kirkland Lake, Ont.
May 1, 1943.

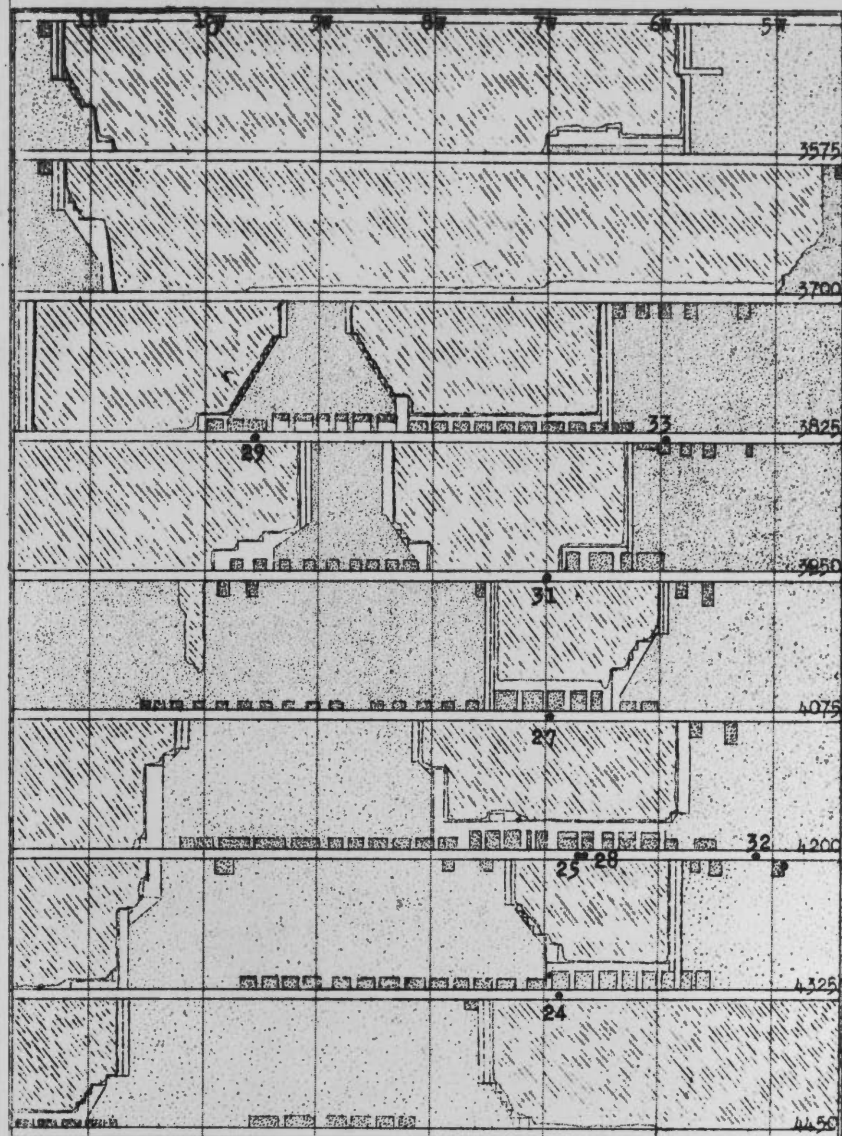
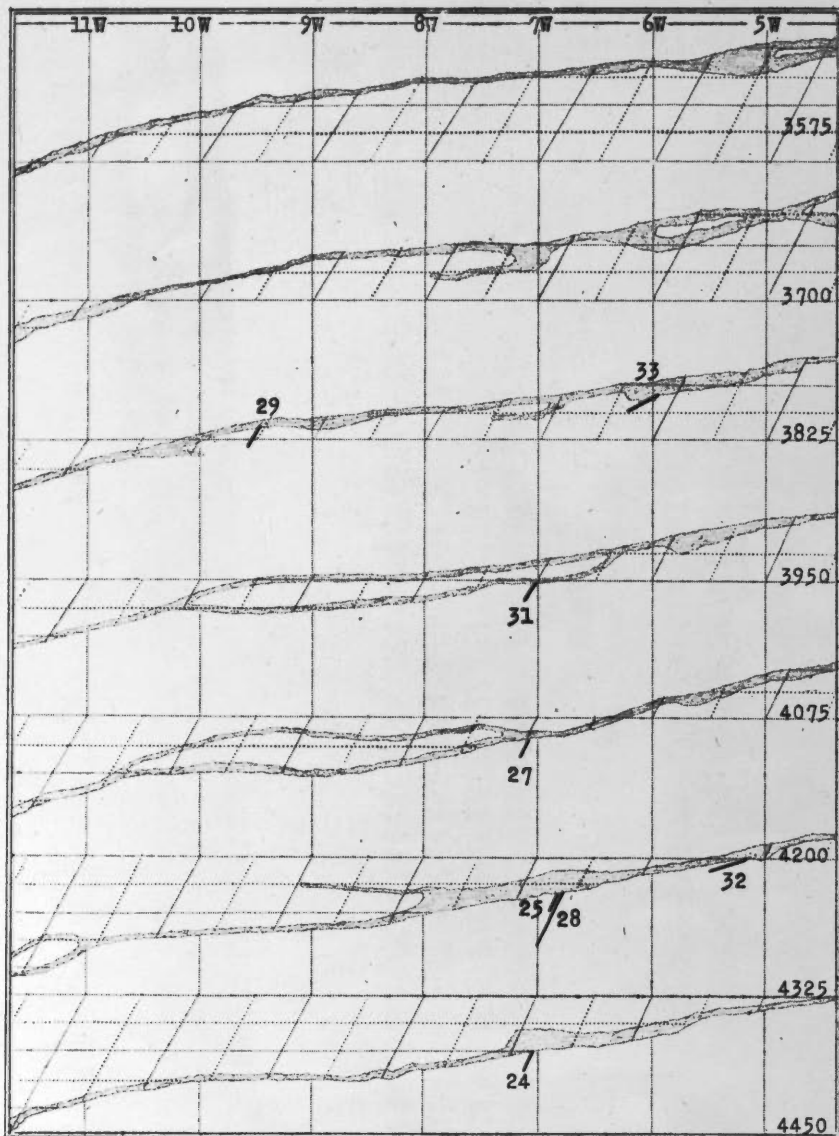
Z.E.G.

APPENDIX I

Test Holes Used January-March, 1943

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The only test holes used for recording purposes in the rock burst research program during the period January-March, 1943, were: Nos. 24, 25, 27, 28, 29, 31, 32, and 33. They are located on the plan and elevation diagrams of this appendix. Plans and elevation have each a vertical scale indicated by the 125' difference between the levels. The section lines are 100' apart. In each diagram, east and west are respectively to the right and left, as one faces the charts. In the projection of the plans, the oblique lines run down and to the left (south) and up and to the right (north), the minimum scale division, both east-west and north-south, being 50'.



Dates of Recording from Test Holes

The only holes used in the recording program were: Nos. 24, 25, 27, 28, 29, 31, 32, and 33. Records were begun in these holes on the dates indicated in the tabulation below. The solid vertical rulings show week ends.

JANUARY

[illegible]

FEBRUARY

[illegible]

MARCH

[illegible]

APPENDIX II

Record Analysis for Holes 24-33, January-March, 1943

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In the following tabulations, the successive headings indicate:

- Rec = Record number.
- On = Date record began.
- To = Date record was removed,
- A, B, C = The three units of an Obert set.
- Db = Attenuation in decibels.
- Gp = Geophone number.
- Epoch = Time, in Eastern War Time, beginning at midnight, on the 24 hr. system, about which the averaging interval falls. In the case of a two-day record, underlines indicate times during the second half of the record. As the records are changed about 7-30 a.m., the first times given on any day are p.m.
- Time = Number of minutes in the averaging interval.
- Lrge = Average number per minute of large snaps, as recorded by the fast stylus.
- Med = As above for large, but for medium snaps.
- Small = As above for large, but for small snaps.
- Total = Average number per minute of all snaps as recorded by the fast stylus.
- N = Serial number of comparator sheet concerned.
- Con-Rec = Concurrent records, first and second.
- Coinc = Coincidences between records. The first entry shows the number of coincidences between the record being tabulated and the first concurrent record for the entire averaging interval; the second shows the number of coincidences between the record being tabulated and the second concurrent record, for the same interval unless a difference is indicated in the notes.
- Remarks = Index letters to a series of notes following the tabulation for each test hole.

H24

Roc	On	To	A	B	C	Db	Gp	Epoch	Time	Large	Med	Small	Total	N	Con-Rec	Coine	Remarks
	Ja	Ja															
361	2	4	3	3	3	7	3	16:48	16	.25	3.44	23.12	26.81	2	H28	H29	5 - A.
361	2	4	3	3	3	7	3	18:48	16	.38	2.00	14.43	16.81	4	H28	H29	14 - A.
361	2	4	3	3	3	7	3	4:52	16	.31	2.88	14.56	17.75	5	H28	H29	11 - A.
361	2	4	3	3	3	7	3	6:48	16	.19	1.44	6.06	7.69	7	H28	H29	13 - A.
361	2	4	3	3	3	7	3	16:46	16	.25	.69	6.00	6.94	9	H28	H29	12 - A.
361	2	4	3	3	3	7	3	18:48	16	.06	1.56	5.69	7.31	11	H28	H29	13 - A.
361	2	4	3	3	3	7	3	4:47	16	.50	.94	5.37	6.81	13	H28	H29	12 - A.
361	2	4	3	3	3	7	3	6:48	16	.12	.37	5.31	5.80	15	H28	H29	2 - A.
364	4	5	3	3	3	7	3	16:46	16	.19	6.25	22.06	28.50	17	H28	H29	6 - B.
364	4	5	3	3	3	7	3	18:46	16	.19	2.94	14.87	18.00	19	H28	H29	9 - B.
364	4	5	3	3	3	7	3	4:44	13	1.00	3.23	13.77	18.00	21	H28	H29	23 - B, C.
364	4	5	3	3	3	7	3	6:42	15	.67	2.33	7.80	10.80	23	H28	H29	17 - B, D.
367	5	6	3	3	3	7	1	16:46	16	1.31	4.75	13.81	19.87	25	H28	H29	15 3 E.
367	5	6	3	3	3	7	1	18:46	16	.31	2.00	9.62	11.93	27	H28	H29	7 2
367	5	6	3	3	3	7	1	4:44	16	.75	.87	6.44	8.06	29	H28	H29	15 8
367	5	6	3	3	3	7	1	6:48	16	.62	1.62	6.62	8.86	31	H28	H29	17 4
370	6	7	3	3	3	7	3	16:46	16	.19	.75	12.25	13.19	33	H28	H29	- - F, G.
370	6	7	3	3	3	7	3	17:46	16	.12	.25	19.31	19.68	35	H28	H29	- - F, G.
370	6	7	3	3	3	7	3	18:46	16	.19	1.06	16.69	17.94	37	H28	H29	- - F, G.
370	6	7	3	3	3	7	3	4:48	16	.31	.31	17.81	18.43	39	H28	H29	8 - G.
370	6	7	3	3	3	7	3	5:46	16	.06	.31	22.00	22.37	41	H28	H29	1 - G.
370	6	7	3	3	3	7	3	6:40	-	-	-	-	-	43	H28	H29	- - H.
373	7	8	3	3	3	7	3	16:44	16	.75	3.81	19.50	24.06	45	H28	-	15 - I.
373	7	8	3	3	3	7	3	17:42	16	.12	1.87	13.81	15.80	47	H28	-	6 - I.
373	7	8	3	3	3	7	3	18:48	16	.31	2.25	11.87	14.43	49	H28	-	7 - I.
373	7	8	3	3	3	7	3	4:46	16	.25	1.12	9.94	11.31	51	H28	-	13 - I.
373	7	8	3	3	3	7	3	5:46	16	.44	1.06	9.25	10.75	53	H28	-	10 - I.
373	7	8	3	3	3	7	3	6:40	15	.47	1.07	7.00	8.54	55	H28	-	8 - I, J.
375	8	9	3	3	3	7	3	16:44	16	.50	1.50	6.12	8.12	57	H28	H29	17 9
375	8	9	3	3	3	7	3	17:40	16	.19	.81	4.81	5.81	59	H28	H29	11 4
375	8	9	3	3	3	7	3	18:40	16	.37	.75	5.62	6.74	61	H28	H29	10 6
375	8	9	3	3	3	7	3	4:46	16	.31	.81	8.31	9.43	63	H28	H29	8 4

H24 (Continued)

Rec	On	To	A	B	C	Db	Gp	Epoch	Time	Lrge	Med	Small	Total	N	Con-Rec	Coinc	Remarks
	Ja	Ja															
375	8	9	3	3	3	7	3	5:44	16	.19	.69	5.00	5.88	65	H28 H29	4	3
375	8	9	3	3	3	7	3	6:48	14	.78	.43	5.21	6.42	67	H28 H29	7	7 K.
378	9	11	3	3	3	7	3	16:39	16	.31	1.75	14.19	16.25	69	H28 H29	-	3 L.
378	9	11	3	3	3	7	3	17:41	16	.44	1.19	9.00	10.63	71	H28 H29	-	10 L.
378	9	11	3	3	3	7	3	18:49	16	.19	.94	7.00	8.13	73	H28 H29	-	6 L.
378	9	11	3	3	3	7	3	4:42	16	.06	.19	2.87	3.12	75	H28 H29	-	6 L.
378	9	11	3	3	3	7	3	5:46	16	.19	.56	3.00	3.75	77	H28 H29	-	5 L.
378	9	11	3	3	3	7	3	6:42	16	.37	.19	3.50	4.06	79	H28 H29	-	9 L.
378	9	11	3	3	3	7	3	16:41	16	0.00	.25	3.31	3.56	81	H28 H29	-	1 L.
378	9	11	3	3	3	7	3	17:40	16	.06	.25	2.81	3.12	83	H28 H29	-	3 L.
378	9	11	3	3	3	7	3	18:40	16	.06	.37	2.25	2.68	85	H28 H29	-	6 L.
378	9	11	3	3	3	7	3	4:48	16	.31	.31	2.75	3.37	87	H28 H29	-	7 L.
378	9	11	3	3	3	7	3	5:46	16	.06	.12	3.37	3.55	89	H28 H29	-	2 L.
378	9	11	3	3	3	7	3	6:46	16	.19	2.12	27.69	30.00	91	H28 H29	-	1 L, M.
381	11	12	3	3	3	7	3	16:41	16	.56	.43	9.43	10.43	93	H28 H29	7	5
381	11	12	3	3	3	7	3	17:41	16	.19	.75	13.44	14.38	95	H28 H29	7	3
381	11	12	3	3	3	7	3	18:41	16	.44	.50	17.56	18.50	97	H28 H29	6	5
381	11	12	3	3	3	7	3	4:42	16	.31	.94	19.31	20.56	99	H28 H29	8	6
381	11	12	3	3	3	7	3	5:44	16	.75	.56	31.56	32.87	101	H28 H29	14	10
381	11	12	3	3	3	7	3	6:42	16	.62	1.56	23.93	26.11	103	H28 H29	7	- N.
385	12	13	3	3	3	7	3	16:15	29	.60	8.45	19.52	28.57	104-5	H28 H29	18	11 O.
385	12	13	3	3	3	7	3	17:15	29	.38	2.28	13.62	16.28	108-9	H28 H29	9	7 P.
385	12	13	3	3	3	7	3	18:15	29	.55	1.62	9.27	11.44	112-13	H28 H29	12	4 P.
385	12	13	3	3	3	7	3	4:15	21.5	.46	1.12	10.88	12.46	116-17	H28 H29	6	2 Q.
385	12	13	3	3	3	7	3	5:16	26	.42	.65	4.15	5.22	120-21	H28 H29	6	1 R.
385	12	13	3	3	3	7	3	6:15	28	.43	.50	3.50	4.43	124-25	H28 H29	10	- R.
388	13	14	3	3	3	7	3	16:15	28	.25	1.43	3.71	5.39	128-29	H28 H29	9	3
388	13	14	3	3	3	7	3	17:17	28	.39	1.03	3.50	4.92	132-33	H28 H29	10	4
388	13	14	3	3	3	7	3	18:17	28	.36	.89	2.82	4.07	136-37	H28 H29	13	9
388	13	14	3	3	3	7	3	4:12	10	.40	1.00	2.40	3.80	140	H28 H29	5	0 R, S.
388	13	14	3	3	3	7	3	5:08	10	.30	1.20	4.10	5.60	142	H28 H29	2	0 R.
388	13	14	3	3	3	7	3	6:16	10	.40	1.70	.90	3.00	144	H28 H29	5	0 R.

H24 (Continued)

Rec	On	To	A	B	C	Db	Gp	Epoch	Time	Lrge	Med	Small	Total	N	Con-Rec	Coinc	Remarks
	Ja	Ja															
391	14	15	3	3	3	7	3	16:09	16	.31	10.00	23.19	33.50	146	H28 H29	3 3	
391	14	15	3	3	3	7	3	17:17	16	.56	4.12	12.31	16.99	148	H28 H29	7 4	
391	14	15	3	3	3	7	3	18:11	16	.37	2.12	9.94	12.43	150	H28 H29	5 5	
391	14	15	3	3	3	7	3	4:10	16	.69	1.69	4.62	7.00	152	H28 H29	18 4	
391	14	15	3	3	3	7	3	5:24	16	.25	1.25	3.37	4.87	154	H28 H29	6 4	
391	14	15	3	3	3	7	3	6:12	16	.37	1.19	4.94	6.50	156	H28 H29	6 5	
394	15	16	3	3	3	7	3	16:12	16	1.69	.81	6.37	8.87	158	H25 H29	6 6	T.
394	15	16	3	3	3	7	3	17:12	16	.56	1.31	4.56	6.43	160	H25 H29	14 3	
394	15	16	3	3	3	7	3	18:18	16	.56	1.31	3.50	5.37	162	H25 H29	9 7	
394	15	16	3	3	3	7	3	4:12	16	.69	1.44	13.06	15.19	164	H25 H29	9 8	U.
394	15	16	3	3	3	7	3	5:18	16	.19	1.62	4.19	6.00	166	H25 H29	10 3	
394	15	16	3	3	3	7	3	6:12	16	.56	.94	3.12	4.62	168	H25 H29	15 14	
397	16	18	3	3	3	7	3	16:19	16	1.75	8.31	21.19	31.25	170	H25 H29	29 6	
397	16	18	3	3	3	7	3	17:11	16	.44	2.12	8.56	11.12	172	H25 H29	13 8	
397	16	18	3	3	3	7	3	18:17	16	.31	2.75	6.00	9.06	174	H25 H29	13 7	
397	16	18	3	3	3	7	3	4:18	16	.62	1.31	8.12	10.05	176	H25 H29	11 11	
397	16	18	3	3	3	7	3	5:12	16	.37	1.44	7.50	9.31	178	H25 H29	9 7	
397	16	18	3	3	3	7	3	6:20	16	.31	.87	5.44	6.62	180	H25 H29	6 6	
397	16	18	3	3	3	7	3	16:25	15	.13	.60	6.33	7.06	182	H25 H29	2 2	
397	16	18	3	3	3	7	3	17:16	16	.44	.50	5.94	6.88	184	H25 H29	7 1	
397	16	18	3	3	3	7	3	18:18	16	.31	.94	9.25	10.50	186	H25 H29	12 2	
397	16	18	3	3	3	7	3	4:14	16	.25	.56	18.62	19.43	188	H25 H29	6 3	
397	16	18	3	3	3	7	3	5:12	16	.19	.31	24.81	25.31	190	H25 H29	4 0	
397	16	18	3	3	3	7	3	6:14	16	.31	.37	23.62	24.30	192	H25 H29	6 4	
400	18	19	3	3	3	7	3	16:13	16	.94	1.44	9.69	12.07	194	H28 H29	20 3	V.
400	18	19	3	3	3	7	3	17:19	16	.37	1.44	5.25	7.06	196	H28 H29	6 6	
400	18	19	3	3	3	7	3	18:16	16	.25	.42	4.33	5.00	198	H28 H29	3 1	
400	18	19	3	3	3	7	3	4:14	16	.06	.75	10.56	11.37	200	H28 H29	1 0	
400	18	19	3	3	3	7	3	5:14	16	.12	.56	13.12	13.80	202	H28 H29	3 0	
400	18	19	3	3	3	7	3	6:24	12	.25	.91	14.42	15.58	204	H28 H29	5 2	W.
403	19	20	3	3	3	7	3	16:13	16	.56	6.37	24.25	31.18	206	H28 H29	11 11	
403	19	20	3	3	3	7	3	17:11	16	.50	2.87	11.19	14.56	208	H28 H29	11 8	

H24 (Continued)

Rec	On	To	A	B	C	Db	Gp	Epoch	Time	Lrge	Med	Small	Total	N	Con-Rec	Coinc	Remarks
	Ja	Ja															
403	19	20	3	3	3	7	3	18:13	16	.19	1.50	7.75	9.44	210	H28 H29	8 5	
403	19	20	3	3	3	7	3	4:16	16	.44	1.44	5.31	7.19	212	H28 H29	5 4	X.
403	19	20	3	3	3	7	3	5:14	16	.31	.87	3.12	4.30	214	H28 H29	1 0	Y.
403	19	20	3	3	3	7	3	6:12	16	.25	.87	1.69	2.81	216	H28 H29	8 4	
406	20	21	3	3	3	7	3	16:17	16	.69	5.56	20.50	26.75	218	H28 H29	13 12	Z.
406	20	21	3	3	3	7	3	17:15	16	.44	2.37	9.62	12.43	220	H28 H29	13 11	
406	20	21	3	3	3	7	3	18:15	16	.25	1.37	8.87	10.49	222	H28 H29	9 8	
406	20	21	3	3	3	7	3	4:18	16	.37	.94	3.62	4.93	224	H28 H29	6 5	A'.
406	20	21	3	3	3	7	3	5:12	16	.12	.56	2.75	3.43	226	H28 H29	3 2	
406	20	21	3	3	3	7	3	6:14	16	.25	.56	3.31	4.12	228	H28 H29	2 2	
409	21	22	3	3	3	7	3	16:15	16	.56	2.19	13.50	16.25	230	H28 H29	5 4	B'.
409	21	22	3	3	3	7	3	17:21	16	.44	.94	5.62	7.00	232	H28 H29	13 5	
409	21	22	3	3	3	7	3	18:15	16	.12	1.12	4.75	5.99	234	H28 H29	8 4	
409	21	22	3	3	3	7	3	4:16	16	.25	.69	2.43	3.37	236	H28 H29	11 7	C'.
409	21	22	3	3	3	7	3	5:14	16	.44	.75	3.62	4.81	238	H28 H29	15 9	
409	21	22	3	3	3	7	3	6:14	16	.06	.81	3.75	4.62	240	H28 H29	4 4	
412	22	23	3	3	3	7	3	16:21	16	1.12	9.62	34.31	45.05	242	H28 H29	6 2	D'.
412	22	23	3	3	3	7	3	17:17	16	.37	4.12	19.81	24.30	244	H28 H29	6 1	
412	22	23	3	3	3	7	3	18:17	16	.37	3.62	13.00	16.99	246	H28 H29	6 3	
412	22	23	3	3	3	7	3	4:15	16	.06	1.56	8.44	10.06	248	H28 H29	1 1	
412	22	23	3	3	3	7	3	5:15	16	.12	.94	7.37	8.43	250	H28 H29	5 3	E'.
412	22	23	3	3	3	7	3	6:15	16	.19	1.06	3.62	4.87	252	H28 H29	8 6	
415	23	25	3	3	3	7	3	16:15	16	.31	1.81	6.31	8.43	254	H28 H29	6 1	
415	23	25	3	3	3	7	3	17:15	16	.12	1.50	4.75	6.37	256	H28 H29	5 3	
415	23	25	3	3	3	7	3	18:15	16	.12	.81	3.62	4.55	258	H28 H29	5 1	
415	23	25	3	3	3	7	3	4:17	16	.56	.56	2.50	3.62	260	H28 H29	10 2	F'.
415	23	25	3	3	3	7	3	5:19	16	.25	.69	4.00	4.94	262	H28 H29	7 5	
415	23	25	3	3	3	7	3	6:17	16	.25	.44	2.37	3.06	264	H28 H29	10 8	
415	23	25	3	3	3	7	3	16:17	16	.19	.56	1.19	1.94	266	H28 H29	5 2	
415	23	25	3	3	3	7	3	17:17	16	.19	.81	2.00	3.00	268	H28 H29	10 3	
415	23	25	3	3	3	7	3	18:19	16	.37	.50	1.50	2.37	270	H28 H29	9 8	
415	23	25	3	3	3	7	3	4:19	16	.19	.69	4.37	5.25	272	H28 H29	5 1	G'.

H24 (Continued)

Rec	On	To	A	B	C	Db	Gp	Epoch	Time	Lrge	Med	Small	Total	N	Con-Rec	Coine	Remarks
	Ja	Ja															
415	23	25	3	3	3	7	3	5:21	16	.31	.56	1.75	2.62	274	H28	H29	7 3 G'.
415	23	25	3	3	3	7	3	6:21	16	.06	.25	.81	1.12	276	H28	H29	5 3 G'.
418	25	26	3	3	3	7	3	16:19	16	.37	1.37	8.37	10.11	278	H28	H29	11 4
418	25	26	3	3	3	7	3	17:23	16	.19	.44	5.81	6.44	280	H28	H29	7 2
418	25	26	3	3	3	7	3	18:17	16	.19	.75	3.69	4.63	282	H28	H29	7 3
418	25	26	3	3	3	7	3	4:17	16	.31	1.19	13.87	15.37	284	H28	H29	5 2 H'.
418	25	26	3	3	3	7	3	5:17	16	.12	.69	6.06	6.87	286	H28	H29	6 2
418	25	26	3	3	3	7	3	6:17	16	.31	.12	6.69	7.12	288	H28	H29	8 4
421	26	27	3	3	3	7	3	16:21	16	.12	.25	3.12	3.49	290	H28	H29	5 4 I'.
421	26	27	3	3	3	7	3	17:17	16	.25	.31	1.81	2.37	292	H28	H29	8 3
421	26	27	3	3	3	7	3	18:17	16	.25	.56	1.37	2.18	294	H28	H29	9 4
421	26	27	3	3	3	7	3	4:21	16	.31	.31	12.12	12.74	296	H28	H29	5 1 J'.
421	26	27	3	3	3	7	3	5:17	16	.25	.25	7.25	7.75	298	H28	H29	4 3
421	26	27	3	3	3	7	3	6:23	16	.06	.37	12.37	12.80	300	H28	H29	0 0
424	27	28	3	3	3	7	3	16:17	16	.56	.94	4.25	5.75	302	H28	H29	27 26
424	27	28	3	3	3	7	3	17:17	16	.25	.62	2.19	3.06	304	H28	H29	6 0 K'.
424	27	28	3	3	3	7	3	18:17	16	.31	.31	2.12	2.74	306	H28	H29	16 5
424	27	28	3	3	3	7	3	4:17	16	.06	1.06	8.94	10.06	308	H28	H29	3 0 L'.
424	27	28	3	3	3	7	3	5:17	16	.37	.31	3.00	3.68	310	H28	H29	13 6
424	27	28	3	3	3	7	3	6:21	16	.19	.31	2.62	3.12	312	H28	H29	10 9
427	28	29	3	3	3	7	3	16:17	16	1.25	.69	4.75	6.69	314	H28	-	15 - M', N'.
427	28	29	3	3	3	7	3	17:19	16	.50	.81	1.75	3.06	316	H28	-	21 - M'.
427	28	29	3	3	3	7	3	18:17	16	.44	.31	2.31	3.06	318	H28	-	17 - M'.

Remarks H24

- A. Record 362(H29) quite useless due to open circuit.
- B. Record 365(H29) quite useless due to open circuit.
- C. A burst lasting about 2 min. began 4-39 a.m., Jan. 5, and was about equally well recorded on record 363(H28). Averages taken over only 13 min.
- D. An interruption for 1 min. due to electrical disturbance "breakers".
- E. Coincidences with record 368(H29) are difficult to determine due to extremely active conditions on 3801W9.
- F. Record 371(H29) almost quiescent except for salvos of about a minute to 3 min. duration which could not be counted. Record 370(H24) was having contact trouble (time switch) but the zero was not very widely displaced so count was made for what it might be worth.
- G. New schedule begun, 4-7 in alternate half hour runs.
- H. Time switch trouble, No record.
- I. No record on 3801W9.
- J. "Breakers" disturb one min. of the recording.
- K. Trouble on line (?) at 6-44 (page 37534). It seems to be electrical as part of it was heard by E.A.H. during listening time and so identified on the record. Two min. omitted from count.
- L. Record 377(H28, H25) (Jan. 9-11) useless due to mistake in setting attenuator after modifications to recorder.
- M. Remarkable series of "breakers" on page 37867.
- N. Record 382(H29) had time switch trouble during this section of its run.
- O. The first section of this record analysed into 9 classes.
- P. Coincidences checked out by E.A.H. from the record books as the comparison of records was in error.
- Q. Record shows salvos with the initial times (a.m. Jan. 13) and duration in minutes indicated as follows: 4-04(2); 4-14(2); 4-21(5). These are not shown on record 383(H29).
- R. See Note U for H29.

Remarks H24 (Continued)

- S. Several heavy snaps occurred close together at about 4-20 a.m. Jan. 14. Well marked on H24 and H28 and faintly showing on H29. Compare pages 38820B, 38720A, and 38620A. A heavy salvo began about 4-25 and lasted for nearly 4 min. Compare 38821A, 38720B, and 38620A. It recorded well on H28, rather faintly on H24, and not at all on H29.
- T. A heavy salvo lasting about 30 sec. registered at 4-13 a.m. Jan. 15. It was well registered on H24 and H28 and appears somewhat less on H29. Compare pages 39402B, 39302B, and 39202B.
- U. See Note A' for H29.
- V. Small salvo beginning 4-19 p.m. Jan. 18 and lasting about a minute. On H24 only. No trace on H28 or H29. cf. 40003, 39903, 39803 at X.
- W. Program clock accidentally turned on 15 min. too late on this run.
- X. See Note T for H28.
- Y. See Note U for H28.
- Z. See Note E' for H29.
- A'. See Note W for H28.
- B'. Activity resembling blasting at times when no blasting was going on in Lake Shore. Severe on H28, less so on H24, and almost absent on H29. Compare pages 40904A, 40804A, and 40704A. Also compare pages 40801B and 40802B, with corresponding pages in records 409 and 408.
- G'. See Note X for H28.
- D'. See Note Y for H28.
- E'. See Note Z for H28.
- F'. See Note A' for H28.
- G'. Stylus voltage too high.
- H'. See Note C' for H28.
- I'. See Note D' for H28.
- J'. See Note E' for H28.

Remarks H24 (Continued)

K'. Stylus voltage too high.

L'. Slight traces of small salvo beginning about 4-14 a.m. and lasting about a minute. It was much better marked on 423(H28) and was not registered at all on 422(H29). Compare pages 42419, 42319 and 42219.

M'. A heavy crush burst occurred at 2-12 a.m. Eastern War Time, Jan 29. Record 425(H29, H31) (Jan. 28-29) was lost when the doghouse on 3801W9 was buried.

N'. A strong salvo lasting less than a minute registered on H24 at 4-06 p.m. Jan. 28. It was also well marked on H28. Another less severe, of about the same length, registered at 4-19 p.m. and was about equally well marked on H24 and H28. Compare pages (42701 and 42601) and (42703A and 42603A).

H25

Rec	On	To	A	B	C	Db	Gp	Epoch	Time	Lrge	Med	Small	Total	N	Con-Rec	Coinc	Remarks
	Ja	Ja															
360	2	2	2	2	2	0	4	16:20	16	1.13	3.88	18.50	23.50	1	H26 H29	- -	A.
360	2	4	2	2	2	0	4	18:22	16	.38	3.13	11.63	15.14	3	H26 H29	- -	A.
360	2	4	2	2	2	0	4	4:20	-	-	-	-	-	-	H26 H29	- -	A, B.
360	2	4	2	2	2	0	4	6:22	16	.44	2.56	6.94	9.94	6	H26 H29	- -	A.
360	2	4	2	2	2	0	4	16:20	16	.87	2.37	6.37	9.61	8	H26 H29	- -	A.
360	2	4	2	2	2	0	4	18:18	16	.50	1.69	7.25	9.44	10	H26 H29	- -	A.
360	2	4	2	2	2	0	4	4:17	16	.44	2.69	7.69	10.82	12	H26 H29	- -	A.
360	2	4	2	2	2	0	4	6:20	16	.37	2.06	6.56	8.99	14	H26 H29	- -	A.
363	4	5	2	2	2	0	4	16:18	16	.87	5.44	12.94	19.25	16	H27 H29	16	- C.
363	4	5	2	2	2	0	4	18:18	16	.62	2.75	9.81	13.18	18	H27 H29	15	- C.
363	4	5	2	2	2	0	4	4:10	16	1.25	2.06	5.19	8.50	20	H27 H29	18	- C, D.
363	4	5	2	2	2	0	4	6:10	14	.21	.93	4.29	5.43	22	H27 H29	4	- C, E.
366	5	6	2	2	2	0	4	16:14	16	.50	1.12	2.81	4.43	24	H27 H29	11	1 C, F.
366	5	6	2	2	2	0	4	18:16	16	.31	.75	3.12	4.18	26	H27 H29	9	5
366	5	6	2	2	2	0	4	4:20	16	.44	1.12	4.94	6.50	28	H27 H29	11	5
366	5	6	2	2	2	0	4	6:10	16	.75	.62	2.87	4.24	30	H27 H29	16	10
369	6	7	2	2	2	0	4	16:18	16	2.06	.81	4.12	6.98	32	H27 H29	- -	G, H.
369	6	7	2	2	2	0	4	17:14	16	.06	1.31	3.31	4.68	34	H27 H29	- -	G, H.
369	6	7	2	2	2	0	4	18:14	16	.25	.75	2.75	3.75	36	H27 H29	- -	G, H.
369	6	7	2	2	2	0	4	4:14	16	.19	.94	2.69	3.82	38	H27 H29	- -	G, H.
369	6	7	2	2	2	0	4	5:14	16	0.00	.44	2.00	2.44	40	H27 H29	- -	G, H.
369	6	7	2	2	2	0	4	6:14	16	.31	.75	2.44	3.50	42	H27 H29	- -	G, H.
372	7	8	2	2	2	0	4	16:10	16	.44	1.37	5.25	7.06	44	H27	- 15	- I.
372	7	8	2	2	2	0	4	17:16	16	.25	.69	3.69	4.63	46	H27	- 11	- I.
372	7	8	2	2	2	0	4	18:14	16	.31	.69	3.00	4.00	48	H27	- 12	- I.
372	7	8	2	2	2	0	4	4:12	16	1.50	2.94	6.25	10.69	50	H27	- -	- I, J. K.
372	7	8	2	2	2	0	4	5:16	16	.19	.50	2.37	3.06	52	H27	- -	- I, J.
372	7	8	2	2	2	0	4	6:28	16	.31	.44	2.56	3.31	54	H27	- 9	- I.
375	8	9	3	3	3	7	4	16:16	16	.50	.81	3.12	4.43	56	H28 H29	12	7
375	8	9	3	3	3	7	4	17:12	16	.12	.62	3.12	3.86	58	H28 H29	13	6
375	8	9	3	3	3	7	4	18:10	16	.75	.75	2.94	4.44	60	H28 H29	20	9
375	8	9	3	3	3	7	4	4:16	15.5	.64	2.97	5.24	8.85	62	H28 H29	7	3 L.

H25 (Continued)

Rec	On	To	A	B	C	Db	Gp	Epoch	Time	Lrge	Med	Small	Total	N	Con-Rec	Coinc	Remarks
	Ja	Ja															
375	8	9	3	3	3	7	4	5:10	16	.25	.69	4.31	5.25	64	H28	H29	7 5
375	8	9	3	3	3	7	4	6:18	16	.56	.56	1.69	2.81	66	H28	H29	13 10 M.
380	11	12	2	2	2	0	4	16:19	16	.81	.37	1.56	2.74	92	H27	H31	6 - N.
380	11	12	2	2	2	0	4	17:15	16	.12	.75	2.31	3.18	94	H27	H31	9 - N.
380	11	12	2	2	2	0	4	18:11	16	.75	.62	1.93	3.30	96	H27	H31	15 - N.
380	11	12	2	2	2	0	4	4:12	16	1.00	2.43	5.94	9.37	98	H27	H31	7 - N, O.
380	11	12	2	2	2	0	4	5:17	12	1.08	4.83	12.75	18.66	100	H27	H31	15 - N, P.
380	11	12	2	2	2	0	4	6:18	16	.44	1.50	6.12	8.06	102	H27	H31	11 4 Q.
384	12	13	2	2	2	0	4	16:45	29	1.27	1.10	4.24	6.61	106-7	H27	H29	34 18 R.
384	12	13	2	2	2	0	4	17:45	29	.76	.59	4.69	6.04	110-11	H27	H29	11 10 R.
384	12	13	2	2	2	0	4	18:45	26	1.00	.77	3.19	4.96	114-15	H27	H29	14 4 R, S. T.
384	12	13	2	2	2	0	4	4:44	28	1.28	1.93	4.57	7.78	118-19	H27	H29	7 1 U.
384	12	13	2	2	2	0	4	5:44	28	.89	1.14	3.71	5.74	122-23	H27	H29	15 0 V, W.
387	13	14	2	2	2	0	4	16:46	26	.77	.88	1.92	3.57	130-31	H27	H31	18 10
387	13	14	2	2	2	0	4	17:47	26	.50	.85	2.54	3.89	134-35	H27	H31	17 - X.
387	13	14	2	2	2	0	4	18:47	28	.46	.82	1.61	2.89	138-39	H27	H31	17 - X, Y.
387	13	14	2	2	2	0	4	4:48	6.5	.31	3.23	4.00	7.54	141	H27	H31	1 - Z.
387	13	14	2	2	2	0	4	5:56	10	.90	.50	2.90	4.30	143	H27	H31	7 - X.
387	13	14	2	2	2	0	4	6:40	10	.40	1.10	1.20	2.70	145	H27	H31	4 - X.
390	14	15	2	2	2	0	4	16:41	16	.81	2.37	4.37	7.55	147	H27	H31	12 - A'.
390	14	15	2	2	2	0	4	17:51	16	1.00	1.25	4.25	6.50	149	H27	H31	13 - A'.
390	14	15	2	2	2	0	4	18:47	16	.62	.69	2.19	3.50	151	H27	H31	5 0 A'.
390	14	15	2	2	2	0	4	4:42	16	.56	.87	2.75	4.18	153	H27	H31	10 0 A'.
390	14	15	2	2	2	0	4	5:42	16	.81	.62	3.44	4.87	155	H27	H31	12 0 A'.
390	14	15	2	2	2	0	4	6:50	16	.19	.75	2.37	3.31	157	H27	H31	1 3 A'.
393	15	16	2	2	2	0	4	16:12	16	1.62	1.00	3.94	6.56	158	H24	H29	6 7 B'.
393	15	16	2	2	2	0	4	16:52	16	.69	1.25	3.87	5.81	159	H27	H31	18 14
393	15	16	2	2	2	0	4	17:12	16	.75	1.31	3.69	5.75	160	H24	H29	14 3
393	15	16	2	2	2	0	4	17:42	16	.56	.62	3.00	4.18	161	H27	H31	12 8
393	15	16	2	2	2	0	4	18:18	16	.62	1.69	3.00	5.31	162	H24	H29	9 7
393	15	16	2	2	2	0	4	18:42	16	.44	1.25	4.69	6.38	163	H27	H31	7 4
393	15	16	2	2	2	0	4	4:12	16	.81	5.06	12.31	18.18	164	H24	H29	9 10 C'.

H25 (Continued)

Rec	On	To	A	B	C	Db	Gp	Epoch	Time	Lrge	Med	Small	Total	N	Con-Rec	Coinc	Remarks
	Ja	Ja															
393	15	16	2	2	2	0	4	4:40	16	1.44	4.94	6.87	13:25	165	H27	H31	20 13
393	15	16	2	2	2	0	4	5:18	16	.44	1.81	4.25	6.50	166	H24	H29	10 4 D'.
393	15	16	2	2	2	0	4	5:46	16	.50	.62	3.62	4.74	167	H27	H31	11 9
393	15	16	2	2	2	0	4	6:12	16	.62	1.50	3.69	5.81	168	H24	H29	15 14
393	15	16	2	2	2	0	4	6:42	16	.87	1.06	2.44	4.37	169	H27	H31	14 11
396	16	18	2	2	2	0	4	16:19	16	1.81	2.81	7.94	12.56	170	H24	H29	29 6
396	16	18	2	2	2	0	4	16:40	16	.37	1.81	4.62	6.80	171	H27	H31	8 9
396	16	18	2	2	2	0	4	17:11	16	1.62	1.50	5.50	8.62	172	H24	H29	13 8
396	16	18	2	2	2	0	4	17:41	16	.44	.75	4.69	5.88	173	H27	H31	10 8
396	16	18	2	2	2	0	4	18:17	16	.69	1.75	4.50	6.94	174	H24	H29	13 9
396	16	18	2	2	2	0	4	18:41	16	.31	1.19	6.00	7.50	175	H27	H31	6 7
396	16	18	2	2	2	0	4	4:18	16	.94	2.00	9.44	12.38	176	H24	H29	11 11
396	16	18	2	2	2	0	4	4:40	16	.19	.94	7.37	8.50	177	H24	H29	6 3
396	16	18	2	2	2	0	4	5:12	16	.56	1.25	8.62	10.43	178	H24	H29	9 7
396	16	18	2	2	2	0	4	5:42	16	.62	.75	5.81	7.18	179	H27	H31	14 12
396	16	18	2	2	2	0	4	6:20	16	.56	.62	6.31	7.49	180	H24	H29	6 6
396	16	18	2	2	2	0	4	6:46	16	.56	1.00	4.94	6.50	181	H27	H31	13 8
396	16	18	2	2	2	0	4	16:25	15	.19	.75	4.87	5.81	182	H24	H29	2 2
396	16	18	2	2	2	0	4	16:50	16	.37	.81	4.50	5.68	183	H27	H31	6 3
396	16	18	2	2	2	0	4	17:16	16	.56	.56	2.87	3.99	184	H24	H29	7 1
396	16	18	2	2	2	0	4	17:46	16	.31	.94	5.62	6.87	185	H27	H31	8 1
396	16	18	2	2	2	0	4	18:18	16	.44	.50	6.19	7.13	186	H24	H28	12 3
396	16	18	2	2	2	0	4	18:48	16	.25	.81	8.81	9.87	187	H27	H31	8 6
396	16	18	2	2	2	0	4	4:14	16	.19	.75	17:75	18:69	188	H24	H29	6 3
396	16	18	2	2	2	0	4	4:44	16	.31	.75	19.50	20.56	189	H27	H31	6 2
396	16	18	2	2	2	0	4	5:12	16	.25	.31	24.06	24.62	190	H24	H29	4 0
396	16	18	2	2	2	0	4	5:40	16	.37	.69	19.75	20.81	191	H27	H31	7 0 E.
396	16	18	2	2	2	0	4	6:14	16	.25	.69	20.25	21.19	192	H24	H29	6 4
396	16	18	2	2	2	0	4	6:48	16	.44	.75	23.43	24.62	193	H27	H31	8 0
399	18	19	2	2	2	0	4	16:45	16	.31	.87	1.62	2.80	195	H27	H31	12 12
399	18	19	2	2	2	0	4	17:43	16	.31	.50	1.06	1.87	197	H27	H31	9 9
399	18	19	2	2	2	0	4	18:42	16	.31	0.00	1.54	1.85	199	H27	H31	4 3

H25 (Continued)

Rec	On	To	A	B	C	Db	Gp	Epoch	Time	Large	Med	Small	Total	N	Con-Rec	Coinec	Remarks
	Ja	Ja															
399	18	19	2	2	2	0	4	4:42	16	.12	.25	1.87	2.24	201	H27 H31	2 2	
399	18	19	2	2	2	0	4	5:42	16	.06	.25	2.12	2.43	203	H27 H31	6 1	
399	18	19	2	2	2	0	4	6:42	16	.06	.19	5.31	5.56	205	H27 H31	2 1	
402	19	20	2	2	2	0	4	16:41	16	1.94	.94	3.81	6.69	207	H27 H31	14 14	F'.
402	19	20	2	2	2	0	4	17:43	16	.62	1.25	2.87	4.74	209	H27 H31	13 13	
402	19	20	2	2	2	0	4	18:41	16	.56	.62	2.81	3.99	211	H27 H31	12 10	
402	19	20	2	2	2	0	4	4:42	16	.37	2.00	3.62	5.99	213	H27 H31	8 8	G'.
402	19	20	2	2	2	0	4	5:44	16	.44	.94	2.19	3.57	215	H27 H31	6 6	
402	19	20	2	2	2	0	4	6:44	16	.12	.62	1.44	2.18	217	H27 H31	7 7	
405	20	21	2	2	2	0	4	16:43	16	.50	2.00	4.44	6.94	219	H27 H31	10 11	
405	20	21	2	2	2	0	4	17:43	16	.50	.87	2.06	3.43	221	H27 H31	9 10	
405	20	21	2	2	2	0	4	18:47	16	.31	1.00	1.37	2.68	223	H27 H31	9 13	
405	20	21	2	2	2	0	4	4:46	16	.81	1.50	4.06	6.37	225	H27 H31	11 11	H'.
405	20	21	2	2	2	0	4	5:44	16	.81	1.19	3.00	5.00	227	H27 H31	14 16	
405	20	21	2	2	2	0	4	6:44	16	.56	.44	1.75	2.75	229	H27 H31	13 11	
408	21	22	2	2	2	0	4	16:43	16	1.00	1.37	3.81	6.18	231	H27 H31	17 19	
408	21	22	2	2	2	0	4	17:43	16	.37	1.00	2.81	4.18	233	H27 H31	10 12	
408	21	22	2	2	2	0	4	18:43	16	.25	.37	2.25	2.87	235	H27 H31	9 10	
408	21	22	2	2	2	0	4	4:42	16	.56	.69	2.37	3.62	237	H27 H31	11 11	I'.
408	21	22	2	2	2	0	4	5:44	16	.44	.50	2.50	3.44	239	H27 H31	9 13	
408	21	22	2	2	2	0	4	6:44	16	.12	.31	2.19	2.62	241	H27 H31	5 5	
411	22	23	2	2	2	0	4	16:47	16	1.44	3.00	8.69	13.13	243	H27 H31	19 24	J'.
411	22	23	2	2	2	0	4	17:47	16	.75	1.62	4.69	7.06	245	H27 H31	12 6	
411	22	23	2	2	2	0	4	18:47	16	.75	1.56	3.69	6.00	247	H27 H31	12 12	
411	22	23	2	2	2	0	4	4:47	16	.62	1.31	3.50	5.43	249	H27 H31	10 8	
411	22	23	2	2	2	0	4	5:47	16	.31	.75	3.37	4.43	251	H27 H31	11 13	
411	22	23	2	2	2	0	4	6:47	16	.19	.94	3.12	4.25	253	H27 H31	12 13	
414	23	25	2	2	2	0	4	16:43	16	.62	.81	3.25	4.68	255	H27 H31	10 10	
414	23	25	2	2	2	0	4	17:43	16	.37	.94	3.06	4.37	257	H27 H31	7 10	
414	23	25	2	2	2	0	4	18:43	16	.50	.50	2.87	3.87	259	H27 H31	12 13	
414	23	25	2	2	2	0	4	4:45	16	.44	1.44	3.06	4.94	261	H27 H31	13 8	K'.

H25 (Continued)

Rec	On	To	A	B	C	Db	Gp	Epoch	Time	Large	Med	Small	Total	N	Con-Rec	Coinc	Remarks
	Ja	Ja															
414	23	25	2	2	2	0	4	5:45	16	.56	1.56	4.37	6.49	263	H27 H31	9 9	
414	23	25	2	2	2	0	4	6:45	16	.62	.50	1.87	2.99	265	H27 H31	11 11	
414	23	25	2	2	2	0	4	16:49	16	.25	.94	1.81	3.00	267	H27 H31	9 9	
414	23	25	2	2	2	0	4	17:49	16	.25	.56	1.44	2.25	269	H27 H31	4 -	
414	23	25	2	2	2	0	4	18:45	16	.31	.44	1.75	2.50	271	H27 H31	7 4	
414	23	25	2	2	2	0	4	4:45	16	.37	.50	2.87	3.74	273	H27 H31	5 0	
414	23	25	2	2	2	0	4	5:45	16	.44	.75	2.94	4.13	275	H27 H31	12 -	
414	23	25	2	2	2	0	4	6:51	16	.25	.25	1.94	2.44	277	H27 H31	6 7	
417	25	26	2	2	2	0	4	16:49	16	.56	1.56	8.50	10.62	279	H27 H31	13 3	
417	25	26	2	2	2	0	4	17:47	16	.50	.62	7.06	8.18	281	H27 H31	11 14	
417	25	26	2	2	2	0	4	18:45	16	.50	.69	5.25	6.44	283	H27 H31	11 17	
417	25	26	2	2	2	0	4	4:51	16	.12	.12	5.62	5.86	285	H27 H31	2 1	L'.
417	25	26	2	2	2	0	4	5:53	16	.44	.62	8.69	9.75	287	H27 H31	5 1	
417	25	26	2	2	2	0	4	6:49	16	.19	.56	10.12	10.87	289	H27 H31	3 1	
420	26	27	2	2	2	0	4	16:47	16	.75	.37	3.94	5.06	291	H27 H31	13 13	M'.
420	26	27	2	2	2	0	4	17:45	16	.31	.81	2.44	3.56	293	H27 H31	16 14	
420	26	27	2	2	2	0	4	18:45	16	.25	.56	3.19	4.00	295	H27 H31	9 11	N'.
420	26	27	2	2	2	0	4	4:47	16	.19	.94	6.87	8.00	297	H27 H31	2 2	O'.
420	26	27	2	2	2	0	4	5:53	16	.19	1.12	10.12	11.43	299	H27 H31	0 0	
420	26	27	2	2	2	0	4	6:51	16	.37	.62	8.31	9.30	301	H27 H31	0 0	P'.
423	27	28	2	2	2	0	4	16:45	16	1.00	1.31	8.19	10.50	303	H27 H31	47 5	Q'.
423	27	28	2	2	2	0	4	17:49	16	.37	1.06	4.06	5.49	305	H27 H31	16 4	
423	27	28	2	2	2	0	4	18:47	16	.50	1.50	3.00	5.00	307	H27 H31	20 1	
423	27	28	2	2	2	0	4	4:47	16	.44	1.31	9.37	11.12	309	H27 H31	6 5	
423	27	28	2	2	2	0	4	5:44	14.5	.21	.55	5.58	6.34	311	H27 H31	10 4	R'.
423	27	28	2	2	2	0	4	6:45	16	.50	1.06	5.56	7.12	313	H27 H31	15 10	
426	28	29	2	2	2	0	4	16:45	16	.87	.94	3.94	5.75	315	H27 -	27 -	S'.
426	28	29	2	2	2	0	4	17:47	16	.37	.69	3.19	4.25	317	H27 -	20 -	S'.
426	28	29	2	2	2	0	4	18:45	16	.56	.87	3.44	4.87	319	H27 -	20 -	S'.

Remarks H25

- A. Record 361(H26) was useless owing to poor contacts on the time switch and record 362(H29) was useless due to open circuit developing in line.
- B. Record 360(H25) was not dependable due to poor contacts on time switch. The period was abandoned.
- C. Record 365(H29) was useless due to open circuit.
- D. The coincidences with record 364(H27) are for 6 min. only. Thus the coincidences are now 18 in 6 min. as compared with 15-16 in 16 min. some 10 hrs. before.
- E. This record cut to 14 min. due to electrical disturbance (?) lasting about 2 min. beginning about 6-07 a.m. Jan. 5. Moreover concurrent recording with record 364(H27) was for only 4 min.
- F. Coincidences with record 368(H29) are difficult to determine due to great activity on 3801W9.
- G. Time switch contacts out on record 370(H27). No record till 6 a.m. Jan. 7 when F.J.H. went in to listen. The record 371(H29) most peculiar - almost quiescent except for recurrent salvos. Geophone only in 12'. Hole will have to be reamed.
- H. New schedule, 4-7 in half hour runs.
- I. No record on 3801W9 today.
- J. Record 373(H27) useless due to poor contacts on time switch.
- K. One salvo during this period which was counted and a second immediately after, each lasting a little over a minute.
- L. One salvo about 4-16 a.m. Jan. 9 which was counted and another at 4-24 which was omitted for half a minute. These are much better marked on record 374(H28), the 30' hole, than on record 375(H25), the 100' hole in same location. They do not appear at all on record 376(H29). Two other bursts registered at 4-31 and 4-34 which were similarly recorded as to the three holes.
- M. Record 377(H28, H25) (Jan. 9-11) was useless due to Z.E.G. inadvertently leaving the attenuator at infinity setting.

Remarks H25 (Continued)

- N. Record 382(H31) had time switch trouble. Hence no coincidence entry.
- O. See Note B for H31.
- P. Salvo at 5-02 lasting 4 min. on H25 (pg. 38024). Very little shows on H27 (pg. 38124) and H31 was having switch trouble. Another salvo on H25 beginning 5-12 and lasting 4 min. and one beginning 5-17 and lasting 1 min. (pg. 38025). The first of these shows well on H27 (pg. 38125) but H31 still out of order. When H31 did come on for a short time at 5-22 the count was about 160 for the total c.p.m.
- Q. See Note D record 382(H29).
- R. Coincidences checked out by E.A.H. as there had been an error in the comparison work.
- S. A salvo of open pattern lasting less than a minute occurred on record 384(H25). See page 38416A.
- T. Record 383(H29) turned off at 6-45 p.m. Jan. 12 by misset time clock.
- U. Well marked salvo at 4-50 a.m. Jan. 13. It is sharply marked on 384(H25), absent except for well marked large snaps on 385(H27) but shows as small ones on 383(H29). Compare pages 38523A, 38423A, and 38322A. Compare Note W below.
- V. See Note U for H29.
- W. A well marked salvo lasting about a minute began at 5-40 a.m. Jan. 13. It is sharply marked on page 38427B(H25), almost absent on 38528A(H27) and quite absent on 38325A(H29). Compare Note U above.
- X. See note E for H31.
- Y. See Note W for H29.
- Z. A heavy burst registered on record 387(H25) beginning at 4-33 a.m. Jan. 14 and continuing for nearly 12 min. It was only imperfectly marked on H27 and H31 was not well connected - the record is useless. Compare pages 38821B, 38721B, and 38621B. Two other disturbances registered - one beginning about 4-49 and lasting 2 min. and another beginning 4-51 and lasting a minute. There were no traces on H27 or H25. Compare pages 38823, 38723A, and 38623B.
- A'. See Note G for H31.

Remarks H25 (Continued)

- B'. See Note T for H24.
- C'. See Note A' for H29.
- D'. The record shows short groups of strong offsets at irregular intervals.
- E'. See Note K for H31.
- F'. See Note L for H31.
- G'. Short salvo on H25 at 4-42 a.m. Jan. 20. See page 40222A.
No trace on H27 or H31.
- H'. Short salvo on H25 lasting about half a minute and beginning about 4-46 a.m. Jan. 21. The larger snaps of the salvo recorded on H27 and there were slight traces of it on H31. Compare pages 40623A, 40522B, and 40422B.
- I'. Traces of ore skipping. See page 40822 seq.
- J'. A sharp, very short salvo registered on H25 at 4-47 p.m. Jan. 22. Absolutely no trace shows on H24 or H29.
Compare pages 41205B, 41105B, and 41005B.
- K'. See Note M for H31.
- L'. Strong evidences of ore skipping on this run. See page 41723. Compare also 41823.
- M'. Short, strong salvo at 4-36 p.m. lasting less than a minute. Well marked on H27, H25, and H29. Compare pages 42104B, 42004A, and 41904B.
- N'. A strong salvo registered on H25 at 4-00 a.m. Jan. 27 and lasted more than 2 min. (the time switch changed to H28 at about 4-04). The salvo may have been a burst as the program clock had just turned the set on. The disturbance was not well recorded on H27 or H31.
- O'. Strong evidence of ore skipping. See page 42021.
- P'. Stylus voltage too high.
- Q'. Activity on H31 was so great that only 2 min. were counted. Hence coincidences checked for only 2 min.
- R'. See Note V for H31.
- S'. The heavy burst of Jan. 29 buried the doghouse on 3801W9. Record 425(H29, H31) (Jan. 28-29) was not recovered; hence no coincidences with this record are available.
- T'. No record after 4 a.m. Jan. 29. The burst put the recorders out of commission.

H27

Rec	On	To	A	B	C	Db	Gp	Epoch	Time	Lrge	Med	Small	Total	N	Con-Rec	Coinec	Remarks
	Ja	Ja															
364	4	5	3	3	3	7	6	16:18	16	.62	.94	3.06	4.62	16	H25 H29	16	- A.
364	4	5	3	3	3	7	6	18:18	16	.62	.31	2.25	3.18	18	H25 H29	15	- A.
364	4	5	3	3	3	7	6	4:05	6	2.50	5.00	11.33	18.83	20	H25 H29	18	- A, B.
364	4	5	3	3	3	7	6	6:10	5	.60	3.40	11.00	15.00	22	H25 H29	4	- A, C.
367	5	6	3	3	3	7	6	16:14	16	.62	2.19	6.94	9.75	24	H25 H29	11	1 D.
367	5	6	3	3	3	7	6	18:16	16	.44	1.87	6.37	8.68	26	H25 H29	9	5
367	5	6	3	3	3	7	6	4:20	16	.56	3.50	7.25	11.31	28	H25 H29	11	5
367	5	6	3	3	3	7	6	6:10	16	.81	1.62	6.25	8.68	30	H25 H29	16	10
370	6	7	3	3	3	7	6	16:18	-	-	-	-	-	32	H25 H29	-	- E, F.
370	6	7	3	3	3	7	6	17:14	-	-	-	-	-	34	H25 H29	-	- E, F.
370	6	7	3	3	3	7	6	18:14	-	-	-	-	-	36	H25 H29	-	- E, F.
370	6	7	3	3	3	7	6	4:14	-	-	-	-	-	38	H25 H29	-	- E, F.
370	6	7	3	3	3	7	6	5:14	-	-	-	-	-	40	H25 H29	-	- E, F.
370	6	7	3	3	3	7	6	6:14	-	-	-	-	-	42	H25 H29	-	- E, F.
373	7	8	3	3	3	7	6	16:10	16	1.06	2.81	13.56	17.43	44	H25	-	15 - G.
373	7	8	3	3	3	7	6	17:16	16	.62	1.44	4.50	6.56	46	H25	-	11 - G.
373	7	8	3	3	3	7	6	18:14	16	.44	.75	4.19	5.38	48	H25	-	12 - G.
373	7	8	3	3	3	7	6	4:12	-	-	-	-	-	50	H25	-	- G, H.
373	7	8	3	3	3	7	6	5:16	-	-	-	-	-	52	H25	-	- G, H.
373	7	8	3	3	3	7	6	6:28	16	.37	1.31	2.75	4.43	54	H25	-	9 - G.
378	9	11	3	3	3	7	6	16:13	16	2.31	1.75	11.75	15.81	68	H25 H29	-	11 I.
378	9	11	3	3	3	7	6	17:09	16	.69	1.37	6.31	8.37	70	H25 H29	-	8 I.
378	9	11	3	3	3	7	6	18:09	16	.37	.81	5.62	6.80	72	H25 H29	-	9 I.
378	9	11	3	3	3	7	6	4:08	16	.12	.56	17.81	18.49	74	H25 H29	-	4 I.
378	9	11	3	3	3	7	6	5:08	16	.50	.94	15.25	16.69	76	H25 H29	-	12 I.
378	9	11	3	3	3	7	6	6:16	16	.12	.44	9.25	9.81	78	H25 H29	-	6 I.
378	9	11	3	3	3	7	6	16:09	16	0.00	0.31	8.50	8.81	80	H25 H29	-	1 I.
378	9	11	3	3	3	7	6	17:16	16	.19	.37	7.56	8.12	82	H25 H29	-	6 I.
378	9	11	3	3	3	7	6	18:10	16	.19	.75	4.50	5.44	84	H25 H29	-	11 I.
378	9	11	3	3	3	7	6	4:10	16	.25	2.56	18:18	20.99	86	H25 H29	-	2 I.
378	9	11	3	3	3	7	6	5:10	16	.06	2.25	21.87	24.18	88	H25 H29	-	5 I.
378	9	11	3	3	3	7	6	6:14	16	.25	1.19	27.50	28.94	90	H25 H29	-	3 I.

H27 (Continued)

Rec	On	To	A	B	C	Db	Gp	Epoch	Time	Lrge	Med	Small	Total	N	Con-Rec	Coinc	Remarks
	Ja	Ja															
381	11	12	3	3	3	7	6	16:19	16	1.50	.50	9.62	11.62	92	H25 H31	6	- J.
381	11	12	3	3	3	7	6	17:15	16	.25	.93	10.75	11.93	94	H25 H31	9	- J.
381	11	12	3	3	3	7	6	18:11	16	.81	.43	10.68	11.92	96	H25 H31	15	- J.
381	11	12	3	3	3	7	6	4:12	16	.94	2.12	17.18	20.24	98	H25 H31	7	- J, K.
381	11	12	3	3	3	7	6	5:08	16	1.94	3.81	23.12	28.87	100	H25 H31	15	- J, L.
381	11	12	3	3	3	7	6	6:18	16	.69	2.06	27.50	30.25	102	H25 H31	11	4 M.
385	12	13	3	3	3	7	6	16:45	29	1.21	1.31	3.27	5.79	106-7	H25 H29	34	18 N.
385	12	13	3	3	3	7	6	17:45	29	.65	1.00	3.00	4.65	110-11	H25 H29	11	9 N.
385	12	13	3	3	3	7	6	18:45	26	.42	.85	2.35	3.62	114-15	H25 H29	14	2 N, O.
385	12	13	3	3	3	7	6	4:44	28	.39	.75	2.82	3.96	118-19	H25 H29	7	1 P.
385	12	13	3	3	3	7	6	5:44	28	.50	.36	2.53	3.39	122-23	H25 H29	15	0 Q.
388	13	14	3	3	3	7	6	16:46	28	.64	.57	1.39	2.60	130-31	H25 H29	18	11
388	13	14	3	3	3	7	6	17:47	28	.43	.64	1.57	2.64	134-35	H25 H29	17	- R.
388	13	14	3	3	3	7	6	18:47	28	.50	.82	2.21	3.53	138-39	H25 H31	17	- R, S.
388	13	14	3	3	3	7	6	4:48	10	.30	.50	.90	1.70	141	H25 H31	1	- T.
388	13	14	3	3	3	7	6	5:56	10	.70	1.10	2.10	3.90	143	H25 H31	7	- R.
388	13	14	3	3	3	7	6	6:40	10	.30	.70	1.30	2.30	145	H25 H31	4	- R.
391	14	15	3	3	3	7	6	16:41	16	.94	1.06	8.75	10.75	147	H25 H31	12	- U.
391	14	15	3	3	3	7	6	17:51	16	.87	.50	25.19	26.56	149	H25 H31	13	0 U.
391	14	15	3	3	3	7	6	18:47	16	.56	.50	39.56	40.62	151	H25 H31	5	0 U.
391	14	15	3	3	3	7	6	4:42	16	.44	.87	1.81	3.12	153	H25 H31	10	0 U.
391	14	15	3	3	3	7	6	5:42	16	.69	1.81	2.06	4.56	155	H25 H31	12	0 U.
391	14	15	3	3	3	7	6	6:50	15	1.80	1.80	34.60	38.20	157	H25 H31	1	3 U, V.
394	15	16	3	3	3	7	6	16:52	16	.56	1.12	4.25	5.93	159	H25 H31	18	14
394	15	16	3	3	3	7	6	17:42	16	.44	.62	2.56	3.62	161	H25 H31	12	8
394	15	16	3	3	3	7	6	18:42	16	.44	.87	6.44	7.75	163	H25 H31	7	3
394	15	16	3	3	3	7	6	4:40	16	1.50	2.00	25.44	28.94	165	H25 H31	20	12 W.
394	15	16	3	3	3	7	6	5:46	16	.62	1.12	36.56	38.30	167	H25 H31	11	9
394	15	16	3	3	3	7	6	6:42	15	1.00	.93	30.20	32.13	169	H25 H31	14	11
397	16	18	3	3	3	7	6	16:40	16	.25	1.00	5.87	7.12	171	H25 H31	8	9
397	16	18	3	3	3	7	6	17:41	16	.50	.44	6.31	7.25	173	H25 H31	10	8
397	16	18	3	3	3	7	6	18:41	16	.25	.69	7.19	8.13	175	H25 H31	6	6

H27 (Continued)

Rec	On	To	A	B	C	Db	Gp	Epoch	Time	Lrge	Med	Small	Total	N	Con-Rec	Coinc	Remarks
	Ja	Ja															
397	16	18	3	3	3	7	6	4:40	16	.31	1.31	7.43	9.05	177	H25 H31	6 3	
397	16	18	3	3	3	7	6	5:42	16	.69	.87	6.69	8.25	179	H25 H31	14 11	
397	16	18	3	3	3	7	6	6:46	16	.69	1.44	6.25	8.38	181	H25 H31	13 8	
397	16	18	3	3	3	7	6	16:50	16	.50	.37	14.56	15.43	183	H25 H31	6 3	
397	16	18	3	3	3	7	6	17:46	16	.44	.50	17.19	18.13	185	H25 H31	8 0	
397	16	18	3	3	3	7	6	18:48	16	.31	.87	29.62	30.80	187	H25 H31	8 6	
397	16	18	3	3	3	7	6	4:44	16	.31	.81	37.06	38.18	189	H25 H31	6 2	
397	16	18	3	3	3	7	6	5:40	16	.37	.25	32.00	32.62	191	H25 H31	7 0	X.
397	16	18	3	3	3	7	6	6:48	16	.37	.81	28.44	29.62	193	H25 H31	8 0	X.
400	18	19	3	3	3	7	6	16:45	16	.56	.94	7.87	9.37	195	H25 H31	12 13	
400	18	19	3	3	3	7	6	17:43	16	.50	.37	6.94	7.81	197	H25 H31	9 9	
400	18	19	3	3	3	7	6	18:42	16	.25	.50	7.62	8.37	199	H25 H31	4 5	
400	18	19	3	3	3	7	6	4:42	16	.19	1.00	17.44	18.63	201	H25 H31	2 2	
400	18	19	3	3	3	7	6	5:42	16	.31	.44	16.44	17.19	203	H25 H31	6 1	
400	18	19	3	3	3	7	6	6:42	16	.12	.31	23.19	23.62	205	H25 H31	2 1	
403	19	20	3	3	3	7	6	16:41	16	1.69	.87	2.25	4.81	207	H25 H31	14 14	Y.
403	19	20	3	3	3	7	6	17:43	16	.37	.87	3.19	4.43	209	H25 H31	13 13	
403	19	20	3	3	3	7	6	18:41	16	.50	.31	1.75	2.56	211	H25 H31	12 10	
403	19	20	3	3	3	7	6	4:42	16	.19	.56	5.00	5.75	213	H25 H31	8 8	
403	19	20	3	3	3	7	6	5:44	16	.25	.37	3.56	4.18	215	H25 H31	6 6	
403	19	20	3	3	3	7	6	6:44	16	.06	.12	1.00	1.18	217	H25 H31	7 7	
406	20	21	3	3	3	7	6	16:43	16	.19	.50	2.75	3.44	219	H25 H31	10 10	
406	20	21	3	3	3	7	6	17:43	16	.06	.31	2.00	2.37	221	H25 H31	9 8	
406	20	21	3	3	3	7	6	18:47	16	.44	.19	1.62	2.25	223	H25 H31	9 9	
406	20	21	3	3	3	7	6	4:46	16	.31	1.19	5.62	7.12	225	H25 H31	11 11	Z.
406	20	21	3	3	3	7	6	5:44	16	.37	.44	2.56	3.37	227	H25 H31	14 14	
406	20	21	3	3	3	7	6	6:44	16	.37	.31	1.87	2.55	229	H25 H31	13 9	
409	21	22	3	3	3	7	6	16:43	16	.75	.56	1.81	3.12	231	H25 H31	17 17	
409	21	22	3	3	3	7	6	17:43	16	.12	.37	.87	1.36	233	H25 H31	10 10	
409	21	22	3	3	3	7	6	18:43	16	.19	.25	1.25	1.69	235	H25 H31	9 9	
409	21	22	3	3	3	7	6	4:42	16	.44	.12	6.25	6.81	237	H25 H31	11 11	
409	21	22	3	3	3	7	6	5:44	16	.29	.29	3.07	3.65	239	H25 H31	9 9	

H27 (Continued)

Rec	On	To	A	B	C	Db	Gp	Epoch	Time	Lrge	Med	Small	Total	N	Con-Rec	Coinc	Remarks
	Ja	Ja															
409	21	22	3	3	3	7	6	6:44	16	.06	.25	2.19	2.50	241	H25 H31	5 5	
412	22	23	3	3	3	7	6	16:47	16	.62	.62	3.31	4.55	243	H25 H31	19 19	
412	22	23	3	3	3	7	6	17:47	16	.50	1.00	2.19	3.69	245	H25 H31	12 6	
412	22	23	3	3	3	7	6	18:47	16	.19	.25	1.81	2.25	247	H25 H31	12 12	
412	22	23	3	3	3	7	6	4:47	16	.37	.56	3.75	4.68	249	H25 H31	10 8	
412	22	23	3	3	3	7	6	5:47	16	.25	.31	3.06	3.62	251	H25 H31	11 11	
412	22	23	3	3	3	7	6	6:47	16	.12	.19	2.56	2.87	253	H25 H31	12 11	
415	23	25	3	3	3	7	6	16:43	16	.44	.12	1.44	2.00	255	H25 H31	10 10	
415	23	25	3	3	3	7	6	17:43	16	.25	.25	1.69	2.19	257	H25 H31	7 7	
415	23	25	3	3	3	7	6	18:43	16	.31	.25	1.50	2.06	259	H25 H31	12 11	
415	23	25	3	3	3	7	6	4:45	16	.19	1.00	2.44	3.63	261	H25 H31	13 8	
415	23	25	3	3	3	7	6	5:45	16	.25	.25	4.62	5.12	263	H25 H31	9 8	
415	23	25	3	3	3	7	6	6:45	16	.37	.31	1.44	2.12	265	H25 H31	11 10	
415	23	25	3	3	3	7	6	16:49	16	.19	.12	1.19	1.50	267	H25 H31	9 9	
415	23	25	3	3	3	7	6	17:49	16	.12	0.00	.69	.81	269	H25 H31	4 -	
415	23	25	3	3	3	7	6	18:45	16	.37	.12	1.31	1.80	271	H25 H31	7 4	
415	23	25	3	3	3	7	6	4:45	16	.31	.19	4.50	5.00	273	H25 H31	5 0	
415	23	25	3	3	3	7	6	5:45	16	.31	.50	2.25	3.06	275	H25 H31	12 -	
415	23	25	3	3	3	7	6	6:51	16	.19	.19	1.81	2.19	277	H25 H31	6 6	
418	25	26	3	3	3	7	6	16:49	16	.25	.44	17.94	18.63	279	H25 H31	13 3	
418	25	26	3	3	3	7	6	17:47	16	.37	.37	14.50	15.24	281	H25 H31	11 11	
418	25	26	3	3	3	7	6	18:45	16	.06	.31	11.94	12.31	283	H25 H31	11 10	
418	25	26	3	3	3	7	6	4:51	16	.37	1.19	29.87	31.43	285	H25 H31	2 0	A'.
418	25	26	3	3	3	7	6	5:53	16	.31	.31	22.06	22.68	287	H25 H31	5 0	
418	25	26	3	3	3	7	6	6:49	16	.12	.12	23.81	24.05	289	H25 H31	3 1	
421	26	27	3	3	3	7	6	16:47	16	.56	.31	6.44	7.31	291	H25 H31	13 12	B'.
421	26	27	3	3	3	7	6	17:45	16	.37	.44	6.50	7.31	293	H25 H31	16 14	
421	26	27	3	3	3	7	6	18:45	16	.19	.25	8.44	8.88	295	H25 H31	9 9	C'.
421	26	27	3	3	3	7	6	4:47	16	.31	.69	23.94	24.94	297	H25 H31	2 1	
421	26	27	3	3	3	7	6	5:53	16	.19	.25	24.12	24.56	299	H25 H31	0 0	
421	26	27	3	3	3	7	6	6:51	16	.19	.37	25.50	26.06	301	H25 H31	0 0	D'.
424	27	28	3	3	3	7	6	16:45	16	1.81	2.44	9.81	14.06	303	H25 H31	47 5	E'.

H27 (Continued)

Rec	On	To	A	B	C	Db	Gp	Epoch	Time	Lrge	Med	Small	Total	N	Con-Rec	Coinc	Remarks
	Ja	Ja															
424	27	28	3	3	3	7	6	17:49	16	.62	.81	7.25	8.68	305	H25	H31	16 4
424	27	28	3	3	3	7	6	18:47	16	.75	.75	6.19	7.69	307	H25	H31	20 1
424	27	28	3	3	3	7	6	4:47	16	.31	.50	13.25	14.06	309	H25	H31	6 5
424	27	28	3	3	3	7	6	5:44	14.5	.21	.69	11.24	12.14	311	H25	H31	10 4 F'.
424	27	28	3	3	3	7	6	6:45	16	.25	.87	9.31	10.43	313	H25	H31	15 10
427	28	29	3	3	3	7	6	16:45	16	1.25	1.12	2.50	4.87	315	H25	-	27 - G'.
427	28	29	3	3	3	7	6	17:47	16	.50	.69	2.69	3.88	317	H25	-	20 - G', H'.
427	28	29	3	3	3	7	6	18:45	16	.69	1.19	2.50	4.38	319	H25	-	20 - G', I'.

Remarks H27

- A. Record 365(H29) was useless due to open circuit.
- B. An open circuit on 364(H27) cut the effective recording to 6 min. The average is taken for this reduced period and the coincidences with record 363(H25) are 18 in 6 min. as compared with 15-16 in 16 min. some 10 hrs. before.
- C. An open circuit on 364(H27) cut the effective recording to 5 min. Effective concurrent recording with 363(H25) lasted only 4 min. - a fact to be noted when comparing coincidences.
- D. Coincidences with record 368(H29) are difficult to determine as the activity on 3801W9 is so great.
- E. Open circuit until 7 a.m. Jan. 7 when F.J.H. went to the set to listen. Time switch contacts out. Hence no coincidences deduced.
- F. New schedule running, 4-7 in half hour runs.
- G. No record on 3801W9.
- H. Time switch contacts out. No record this period.
- I. Record 377(H28, H25) (Jan. 9-11) useless due to mistake in setting attenuator after modifications to recorder.
- J. Voltage too high throughout record 381(H27). Zero much too wide with 25 cycle disturbance. Switch trouble on record 382(H31) prevents coincidence entry.
- K. See Note B for H31.
- L. See Note P for H25.
- M. See Note D record 382(H29).
- N. Coincidences were checked out by E.A.H. on the record books as there had been an error in comparing the records.
- O. Record 383(H29) turned off at 6-45 p.m. Jan. 12 by misset time clock.
- P. See Note U for H25.
- Q. See Note U for H29.
- R. See Note E for H31.

Remarks H27 (Continued)

- S. See Note W for H29.
- T. See Note Z for H25.
- U. See Note G for H31.
- V. This reading for small offsets very doubtful as contacts very poor.
- W. This record shows poor connection on the time switch for the H27 run. The offsets can be read but there is a good deal of 25 cycle oscillation. Toward the end of the run when the pressure lessens the record becomes illegible.
- X. See Note K for H31.
- Y. See Note L for H31.
- Z. See Note H for H25.
- A'. Some evidence of ore skipping on this record. Compare pages 41823 and 41723.
- B'. See Note M' for H25.
- C'. See Note N' for H25.
- D'. Stylus voltage too high.
- E'. Coincidences with H31 were checked only for 2 min. The activity on H31 was very great.
- F'. See Note V for H31.
- G'. The heavy burst of Jan. 29 buried the doghouse on 3801W. The record 425(H29, H31) (Jan. 28-29) was not recovered, hence no coincidences with these records are available.
- H'. Stylus voltage too high.
- I'. The time switch failed to turn H27 on at 4-30 a.m. Jan. 29. The burst had put the recorders out of commission.

H28

Rec	On	To	A	B	C	Db	Gp	Epoch	Time	Lrge	Med	Small	Total	N	Con-Rec	Coine	Remarks
	Ja	Ja															
360	2	4	2	2	2	0	2	16:48	16	.44	.94	2.38	3.76	2	H24	H29	5 - A.
360	2	4	2	2	2	0	2	18:48	16	.63	.56	2.31	3.50	4	H24	H29	14 - A.
360	2	4	2	2	2	0	2	4:52	16	.69	1.75	4.50	6.94	5	H24	H29	11 - A.
360	2	4	2	2	2	0	2	6:48	16	.19	.87	2.62	3.68	7	H24	H29	13 - A.
360	2	4	2	2	2	0	2	16:46	16	.25	.62	2.06	2.93	9	H24	H29	12 - A.
360	2	4	2	2	2	0	2	18:48	16	.19	.87	2.62	3.68	11	H24	H29	13 - A.
360	2	4	2	2	2	0	2	4:47	16	.44	.62	2.44	3.50	13	H24	H29	12 - A.
360	2	4	2	2	2	0	2	6:48	16	.19	.25	2.19	2.63	15	H24	H29	2 - A.
363	4	5	2	2	2	0	2	16:46	16	.44	.81	3.19	4.44	17	H24	H29	7 - B.
363	4	5	2	2	2	0	2	18:46	16	.44	1.56	3.19	5.19	19	H24	H29	9 - B.
363	4	5	2	2	2	0	2	4:44	13	.92	2.77	6.08	9.77	21	H24	H29	23 - B, C.
363	4	5	2	2	2	0	2	6:42	16	.75	1.75	3.50	6.00	23	H24	H29	17 - B, D.
366	5	6	2	2	2	0	2	16:46	16	.94	1.75	3.06	5.75	25	H24	H29	15 3 E.
366	5	6	2	2	2	0	2	18:46	16	.44	.75	2.81	4.00	27	H24	H29	7 2
366	5	6	2	2	2	0	2	4:44	16	.56	.81	3.06	4.43	29	H24	H29	15 8
366	5	6	2	2	2	0	2	6:48	16	.94	1.00	4.12	6.06	31	H24	H29	17 4
369	6	7	2	2	2	0	2	16:46	16	.37	1.19	3.56	5.12	33	H24	H29	- - F, G.
369	6	7	2	2	2	0	2	17:46	16	.62	.87	2.25	3.74	35	H24	H29	- - F, G.
369	6	7	2	2	2	0	2	18:46	16	.94	1.06	2.81	4.81	37	H24	H29	- - F, G.
369	6	7	2	2	2	0	2	4:48	16	.69	1.50	3.44	5.63	39	H24	H29	8 - G.
369	6	7	2	2	2	0	2	5:46	16	.50	.37	2.56	3.43	41	H24	H29	1 - G.
369	6	7	2	2	2	0	2	6:40	16	.75	1.19	4.00	5.94	43	H24	H29	- - H.
372	7	8	2	2	2	0	2	16:44	16	1.12	1.19	3.69	6.00	45	H24	-	15 - I.
372	7	8	2	2	2	0	2	17:42	16	.37	.69	3.19	4.25	47	H24	-	6 - I.
372	7	8	2	2	2	0	2	18:48	16	.50	.87	2.62	3.99	49	H24	-	7 - I.
372	7	8	2	2	2	0	2	4:46	16	.50	2.06	6.00	8.56	51	H24	-	13 - I.
372	7	8	2	2	2	0	2	5:46	16	.69	.94	3.50	5.13	53	H24	-	10 - I.
372	7	8	2	2	2	0	2	6:40	16	.25	.69	2.44	3.38	55	H24	-	8 - I.
374	8	9	2	2	2	0	2	16:16	16	.69	.87	2.12	3.68	56	H25	H29	12 7
374	8	9	2	2	2	0	2	16:44	16	.50	.94	3.19	4.63	57	H24	H29	17 9
374	8	9	2	2	2	0	2	17:12	16	.25	.69	2.43	3.37	58	H25	H29	13 6
374	8	9	2	2	2	0	2	17:40	16	.44	.75	2.56	3.75	59	H24	H29	11 5

H28 (Continued)

Rec	On	To	A	B	C	Db	Gp	Epoch	Time	Lrge	Med	Small	Total	N	Con-Rec	Coinc	Remarks
	Ja	Ja															
374	8	9	2	2	2	0	2	18:10	16	.75	.69	2.44	3.88	60	H25 H29	20	9
374	8	9	2	2	2	0	2	18:40	16	.50	.94	2.44	3.88	61	H24 H29	10	7
374	8	9	2	2	2	0	2	4:16	14.5	1.17	2.48	8.28	11.93	62	H25 H29	7	3 J.
374	8	9	2	2	2	0	2	4:46	16	.44	1.56	4.56	6.56	63	H24 H29	8	4
374	8	9	2	2	2	0	2	5:10	16	.44	.50	1.94	2.88	64	H25 H29	7	5 K.
374	8	9	2	2	2	0	2	5:44	16	.37	.81	2.56	3.74	65	H24 H29	4	4
374	8	9	2	2	2	0	2	6:18	16	.69	.44	2.44	3.57	66	H25 H29	13	10
374	8	9	2	2	2	0	2	6:48	16	.56	.37	2.19	3.12	67	H24 H29	7	9 L.
380	11	12	2	2	2	0	2	16:41	16	.50	.81	2.68	3.99	93	H24 H29	7	5
380	11	12	2	2	2	0	2	17:41	16	.19	.37	.93	1.49	95	H24 H29	7	3
380	11	12	2	2	2	0	2	18:41	16	.37	.94	1.50	2.81	97	H24 H29	6	5
380	11	12	2	2	2	0	2	4:42	16	.62	1.56	2.50	4.68	99	H24 H29	8	8
380	11	12	2	2	2	0	2	5:44	16	.94	1.25	3.50	5.69	101	H24 H29	14	11
380	11	12	2	2	2	0	2	6:42	16	.37	.50	2.06	2.93	103	H24 H29	7	- M.
384	12	13	2	2	2	0	2	16:15	29	2.09	2.38	4.52	8.99	104-5	H24 H29	14	13 N.
384	12	13	2	2	2	0	2	17:15	29	.96	.83	4.00	5.79	108-9	H24 H29	9	8 O.
384	12	13	2	2	2	0	2	18:15	29	.93	1.03	3.59	5.55	112-13	H24 H29	12	4 O.
384	12	13	2	2	2	0	2	4:15	21.5	1.63	1.72	5.95	9.30	116-17	H24 H29	6	3 P.
384	12	13	2	2	2	0	2	5:16	26	.92	.81	2.69	4.42	120-21	H24 H29	6	1 Q.
384	12	13	2	2	2	0	2	6:15	28	.71	.61	2.00	3.32	124-25	H24 H29	10	- Q.
387	13	14	2	2	2	0	2	16:15	24	.87	1.25	2.21	4.33	128-29	H24 H29	9	4
387	13	14	2	2	2	0	2	17:17	28	.82	.96	2.07	3.85	132-33	H24 H29	10	6
387	13	14	2	2	2	0	2	18:17	28	.68	.53	1.68	2.89	136-37	H24 H29	13	10
387	13	14	2	2	2	0	2	4:12	10	.50	.80	2.40	3.70	140	H24 H29	5	0 Q, R.
387	13	14	2	2	2	0	2	5:08	10	1.00	2.60	4.10	7.70	142	H24 H29	2	- Q.
387	13	14	2	2	2	0	2	6:16	10	.40	.90	1.40	2.70	144	H24 H29	5	- Q.
390	14	15	2	2	2	0	2	16:09	16	1.50	1.69	3.94	7.13	146	H24 H29	3	5
390	14	15	2	2	2	0	2	17:17	16	.62	1.31	2.62	4.55	148	H24 H29	7	4
390	14	15	2	2	2	0	2	18:11	16	.69	1.31	3.06	5.06	150	H24 H29	5	5
390	14	15	2	2	2	0	2	4:10	16	1.56	2.44	4.00	8.00	152	H24 H29	18	4
390	14	15	2	2	2	0	2	5:24	16	.37	1.37	1.69	3.43	154	H24 H29	6	4
390	14	15	2	2	2	0	2	6:12	16	.81	1.37	2.31	4.49	156	H24 H29	5	5

H28 (Continued)

Rec	On	To	A	B	C	Db	Gp	Epoch	Time	Lrge	Med	Small	Total	N	Con-Rec	Coine	Remarks
	Ja	Ja															
399	18	19	2	2	2	0	2	16:13	16	1.00	.56	1.19	2.75	194	H24	H29	20 3
399	18	19	2	2	2	0	2	17:19	16	.37	.87	.87	2.11	196	H24	H29	6 6
399	18	19	2	2	2	0	2	18:16	16	.17	.08	.83	1.08	198	H24	H29	3 1
399	18	19	2	2	2	0	2	4:14	16	.12	.25	.56	.93	200	H24	H29	1 1
399	18	19	2	2	2	0	2	5:14	16	.25	.12	.50	.87	202	H24	H29	3 0
399	18	19	2	2	2	0	2	6:23	10	.20	.20	.90	1.30	204	H24	H29	5 2 S.
402	19	20	2	2	2	0	2	16:13	16	1.00	1.44	3.19	5.63	206	H24	H29	11 14
402	19	20	2	2	2	0	2	17:11	16	.67	1.13	2.20	4.00	208	H24	H29	11 10
402	19	20	2	2	2	0	2	18:13	16	.44	.63	1.62	2.69	210	H24	H29	8 5
402	19	20	2	2	2	0	2	4:16	16	1.12	1.06	2.06	4.24	212	H24	H29	5 4 T.
402	19	20	2	2	2	0	2	5:14	16	.06	.25	.37	.68	214	H24	H29	1 0 U.
402	19	20	2	2	2	0	2	6:12	16	.37	.69	1.37	2.43	216	H24	H29	8 5
405	20	21	2	2	2	0	2	16:17	16	1.00	1.62	3.19	5.81	218	H24	H29	13 13 V.
405	20	21	2	2	2	0	2	17:15	16	.87	.56	2.00	3.43	220	H24	H29	13 13
405	20	21	2	2	2	0	2	18:15	16	.44	1.00	2.19	3.63	222	H24	H29	9 11
405	20	21	2	2	2	0	2	4:18	16	.37	.87	1.94	3.18	224	H24	H29	6 7 W.
405	20	21	2	2	2	0	2	5:12	16	.31	.75	3.06	4.12	226	H24	H29	3 3
405	20	21	2	2	2	0	2	6:14	16	.31	.50	2.12	2.93	228	H24	H29	2 2
408	21	22	2	2	2	0	2	16:15	16	1.44	1.19	6.19	8.82	230	H24	H29	5 4
408	21	22	2	2	2	0	2	17:21	16	.81	1.62	2.94	5.37	232	H24	H29	13 6
408	21	22	2	2	2	0	2	18:15	16	.19	1.06	2.94	4.19	234	H24	H29	8 5
408	21	22	2	2	2	0	2	4:16	16	.56	.56	3.00	4.12	236	H24	H29	11 9 X.
408	21	22	2	2	2	0	2	5:14	16	.94	1.06	3.69	5.69	238	H24	H29	15 13
408	21	22	2	2	2	0	2	6:14	16	.25	1.06	3.12	4.43	240	H24	H29	4 4
411	22	23	2	2	2	0	2	16:21	16	2.62	1.62	7.44	11.68	242	H24	H29	6 2 Y.
411	22	23	2	2	2	0	2	17:17	16	1.00	1.50	5.06	7.56	244	H24	H29	6 4
411	22	23	2	2	2	0	2	18:17	16	.87	1.00	4.25	6.12	246	H24	H29	6 4
411	22	23	2	2	2	0	2	4:15	16	.81	1.94	5.69	8.44	248	H24	H29	1 1
411	22	23	2	2	2	0	2	5:15	16	.56	1.06	4.44	6.06	250	H24	H29	5 3 Z.
411	22	23	2	2	2	0	2	6:15	16	.56	1.25	3.12	4.93	252	H24	H29	8 6
414	23	25	2	2	2	0	2	16:15	16	.50	1.12	3.50	5.12	254	H24	H29	6 1
414	23	25	2	2	2	0	2	17:15	16	.37	1.25	2.25	3.87	256	H24	H29	5 4

H28 (Continued)

Rec	On	To	A	B	C	Db	Gp	Epoch	Time	Lrge	Med	Small	Total	N	Con-Rec	Coinc	Remarks
	Ja	Ja															
414	23	25	2	2	2	0	2	18:15	16	.25	.81	2.50	3.56	258	H24	H29	5 2
414	23	25	2	2	2	0	2	4:17	16	.87	.75	2.56	4.18	260	H24	H29	10 5 A'.
414	23	25	2	2	2	0	2	5:19	16	.81	2.12	7.12	10.05	262	H24	H29	7 5 B'.
414	23	25	2	2	2	0	2	6:17	16	.62	.56	2.56	3.74	264	H24	H29	10 8
414	23	25	2	2	2	0	2	16:17	16	.25	.56	2.50	3.31	266	H24	H29	5 3
414	23	25	2	2	2	0	2	17:17	16	.50	.56	2.37	3.43	268	H24	H29	10 4
414	23	25	2	2	2	0	2	18:19	16	.75	.69	1.75	3.19	270	H24	H29	9 11
414	23	25	2	2	2	0	2	4:19	16	.44	.56	3.44	4.44	272	H24	H29	5 1
414	23	25	2	2	2	0	2	5:21	16	.50	.62	2.12	3.24	274	H24	H29	7 3
414	23	25	2	2	2	0	2	6:21	16	.25	.44	1.62	2.31	276	H24	H29	5 3
417	25	26	2	2	2	0	2	16:19	16	.56	1.56	3.50	5.62	278	H24	H29	11 4
417	25	26	2	2	2	0	2	17:23	16	.25	1.19	3.06	4.50	280	H24	H29	7 2
417	25	26	2	2	2	0	2	18:17	16	.37	.69	2.75	3.81	282	H24	H29	7 4
417	25	26	2	2	2	0	2	4:17	14.5	2.00	5.03	8.21	15.24	284	H24	H29	5 3 C'.
417	25	26	2	2	2	0	2	5:17	16	.75	1.25	5.75	7.75	286	H24	H29	6 3
417	25	26	2	2	2	0	2	6:17	16	.62	1.06	2.06	3.74	288	H24	H29	8 5
420	26	27	2	2	2	0	2	16:21	16	.31	.50	3.75	4.56	290	H24	H29	5 4 D'.
420	26	27	2	2	2	0	2	17:17	16	.50	.37	1.81	2.68	292	H24	H29	8 3
420	26	27	2	2	2	0	2	18:17	16	.44	.62	3.19	4.25	294	H24	H29	9 5
420	26	27	2	2	2	0	2	4:21	16	3.00	4.62	12.00	19.62	296	H24	H29	5 1 E'.
420	26	27	2	2	2	0	2	5:17	16	.31	.75	2.25	3.31	298	H24	H29	4 5
420	26	27	2	2	2	0	2	6:23	16	.25	.50	1.81	2.56	300	H24	H29	0 0
423	27	28	2	2	2	0	2	16:17	16	1.87	2.25	4.87	8.99	302	H24	H29	27 45
423	27	28	2	2	2	0	2	17:17	16	.69	1.69	3.44	5.82	304	H24	H29	6 0
423	27	28	2	2	2	0	2	18:17	16	.75	.81	3.06	4.62	306	H24	H29	16 6
423	27	28	2	2	2	0	2	4:17	13.5	.22	1.18	2.67	4.07	308	H24	H29	3 3 F'.
423	27	28	2	2	2	0	2	5:17	16	.62	.37	2.69	3.68	310	H24	H29	13 7
423	27	28	2	2	2	0	2	6:21	16	.56	.87	2.37	3.80	312	H24	H29	10 9
426	28	29	2	2	2	0	2	16:17	16	2.19	1.56	5.06	8.81	314	H24	-	15 - G', H'.
426	28	29	2	2	2	0	2	17:19	16	.94	1.31	3.00	5.25	316	H24	-	21 - G'.
426	28	29	2	2	2	0	2	18:17	16	.94	.94	2.50	4.38	318	H24	-	17 - G'.

Remarks H28

- A. Record 362(H29) quite useless due to open circuit.
- B. Record 365(H29) quite useless due to open circuit.
- C. A burst lasting about 2 min. began 4-39 a.m. Jan. 5 and was about equally well recorded on record 364(H24). Averages taken over only 13 min.
- D. Effective comparison with record 364(H24) limited to 15 min.
- E. Coincidences with record 368(H29) are difficult to determine due to extremely active conditions on 3801W9.
- F. Record 370(H24) was having time switch contact trouble but the zero being not too wide a count was made for what it might be worth. Record 371(H29) was very quiet except for salvos lasting from 1-3 min. These were too rapid to count. Hence no coincidences could be deduced for this period.
- G. New schedule begun, 4-7 in half hour runs.
- H. Record 370(H24) useless. Time switch contact trouble.
- I. No record on 3801W9 today.
- J. One salvo at 4-16 a.m. Jan. 9 and another at 4-24. The first was omitted from the count for a minute, the second for half a minute. These are much better marked on record 374(H28), the 30' hole, than on record 375(H25) the 100' hole in same location. They do not appear at all on record 376(H29). Two other bursts recorded at 4-31 and 4-34 which were similarly recorded as to holes.
- K. Good record of skipping ore on record 374(H28), the 30' hole, at 5 a.m.+ Jan. 9. Barely discernible on 375(H25), the 100' hole in same location. The disturbances were brief but were omitted from the count which is consequently rather lower than it should be.
- L. Record 377(H28, H25) (Jan. 9-11) was useless due to Z.E.G. inadvertently leaving the attenuator at infinity setting.
- M. Record 382(H29) having time switch trouble.
- N. The first section of this record analysed into 9 classes.
- O. Coincidences checked out by E.A.H. from record books as comparison of records was in error.

Remarks H28 (Continued)

- P. Record shows salvos with the initial times (a.m., Jan. 13) and duration in minutes indicated as follows: 4:04(2); 4:14(2); 4:21(5). These are not shown on record 383(H29).
- Q. See Note U for H29.
- R. See Note S for H24.
- S. Program clock accidentally turned on 15 min. too late for this run.
- T. A short salvo at 4-17 a.m. Jan. 20. Well marked on H28 and fairly well on H24. Almost no trace on H29. Compare pages 40320A, 40220A, and 40120A.
- U. Short salvo at 5-25 a.m. Jan. 20. Fairly well marked on H27 and just a trace on H31. Compare pages 40326, 40226, and 40126.
- V. See Note E' for H29.
- W. A short salvo, lasting about half a minute and beginning 4-07 a.m. Jan. 21 recorded a little more on H28 than on H24 but no trace on H29. Compare pages 40619A, 40519A, and 40419A.
- X. Heavy salvo lasting about 2 min. began about 4-26 a.m. Jan. 22. It was well marked on H28, fairly well marked on H24 and practically absent from H29. Compare pages 40921A, 40821A, and 40721A.
- Y. A short heavy series of snaps registered at 4-13 p.m. Jan. 22 on H28. They were less heavily recorded on H24 and almost no trace appears on H29. Compare pages 41202A, 41102A, and 41002A.
- Z. A short heavy salvo registered on H28 at 4-31 a.m. Jan. 23. It was less well marked on H24 and there was no trace on H29. Compare pages 41227A, 41126B, and 41027A.
- A'. A short sharp salvo at 4-23 a.m. Jan. 23. It was well marked on H28, less sharp on H24, and was not registered at all on H29. Compare pages 41520B, 41420A, and 41320B.
- B'. Some evidence of ore skipping. See page 41425.
- C'. A salvo of rather open pattern and lasting 5 min. began about 4-12 a.m. Jan. 26. There were traces only on H24 and no evidence showed on H29. Compare pages 41819B, 41719B, and 41619B.
- A second salvo, lasting about a minute, was registered

Remarks H28 (Continued)

on H28 at 4-19 a.m. There were slight traces on H24 but none on H29. Compare pages 41820A, 41720A, and 41620A.

A series of salvos of strong amplitude began about 4-25 a.m. and continued intermittently for 9 min. They were well marked on H28. Traces appeared on H24 and slight traces also on H29. Compare pages 41821A, 41720B, and 41620B, seq.

D'. What looks like blasting registered at 4-09 p.m. Jan. 26. It was definitely like blasting on H28, less like it on H24 and not recorded at all on H29. Compare pages 42102A, 42001B, and 41902A.

E'. A series of open salvos occurred during this run on H28. They were only barely discernible on H24 and H29. Compare pages 42119, 42018, and 41919, seq.

F'. A small salvo at 4-14 a.m. Jan. 28 interrupted the count. See Note L' for H24.

G'. The record 425(H29, H31) (Jan. 28-29) was lost when the burst of Jan. 29 closed 3801^W9, burying the doghouse. Hence no coincidences are available with H29 or H31.

H'. See Note N' for H24.

H29

Rec	On	To	A	B	C	Db	Gp	Epoch	Time	Lrge	Med	Small	Total	N	Con-Rec	Coinc	Remarks
	Ja	Ja															
362	2	4	1	1	1	7	5	16:20	-	-	-	-	-	1	H26 H25	- -	A.
362	2	4	1	1	1	7	5	16:48	-	-	-	-	-	2	H24 H28	- -	A.
362	2	4	1	1	1	7	5	18:22	-	-	-	-	-	3	H26 H25	- -	A.
362	2	4	1	1	1	7	5	18:48	-	-	-	-	-	4	H24 H28	- -	A.
362	2	4	1	1	1	7	5	4:20	-	-	-	-	-	-	H26 H25	- -	A.
362	2	4	1	1	1	7	5	4:52	-	-	-	-	-	5	H24 H28	- -	A.
362	2	4	1	1	1	7	5	6:22	-	-	-	-	-	6	H26 H25	- -	A.
362	2	4	1	1	1	7	5	6:48	-	-	-	-	-	7	H24 H28	- -	A.
362	2	4	1	1	1	7	5	16:20	-	-	-	-	-	8	H26 H25	- -	A.
362	2	4	1	1	1	7	5	16:46	-	-	-	-	-	9	H24 H29	- -	A.
362	2	4	1	1	1	7	5	18:18	-	-	-	-	-	10	H26 H25	- -	A.
362	2	4	1	1	1	7	5	18:48	-	-	-	-	-	11	H24 H28	- -	A.
362	2	4	1	1	1	7	5	4:17	-	-	-	-	-	12	H26 H25	- -	A.
362	2	4	1	1	1	7	5	4:47	-	-	-	-	-	13	H24 H28	- -	A.
362	2	4	1	1	1	7	5	6:20	-	-	-	-	-	14	H26 H25	- -	A.
362	2	4	1	1	1	7	5	6:48	-	-	-	-	-	15	H24 H28	- -	A.
365	4	5	1	1	1	7	5	16:18	-	-	-	-	-	16	H27 H25	- -	B.
365	4	5	1	1	1	7	5	16:46	-	-	-	-	-	17	H24 H28	- -	B.
365	4	5	1	1	1	7	5	18:18	-	-	-	-	-	18	H27 H25	- -	B.
365	4	5	1	1	1	7	5	18:46	-	-	-	-	-	19	H24 H28	- -	B.
365	4	5	1	1	1	7	5	4:10	-	-	-	-	-	20	H27 H25	- -	B.
365	4	5	1	1	1	7	5	4:44	-	-	-	-	-	21	H24 H28	- -	B.
365	4	5	1	1	1	7	5	6:10	-	-	-	-	-	22	H27 H25	- -	B.
365	4	5	1	1	1	7	5	6:42	-	-	-	-	-	23	H24 H28	- -	B.
368	5	6	1	1	1	7	5	16:14	16	1.19	13.75	48.50	63.44	24	H27 H25	1 1	C.
368	5	6	1	1	1	7	5	16:46	16	.62	4.50	19.39	24.51	25	H24 H28	3 3	C.
368	5	6	1	1	1	7	5	18:16	16	.75	3.62	12.50	16.87	26	H27 H25	5 5	
368	5	6	1	1	1	7	5	18:46	16	.62	3.12	12.87	16.61	27	H24 H28	2 2	
368	5	6	1	1	1	7	5	4:20	16	.94	5.87	29.75	36.56	28	H27 H25	5 5	
368	5	6	1	1	1	7	5	4:44	16	.31	1.44	10.44	12.19	29	H24 H28	8 8	
368	5	6	1	1	1	7	5	6:10	16	1.94	7.37	21.37	30.68	30	H27 H25	10 10	
368	5	6	1	1	1	7	5	6:48	16	.25	1.50	7.56	9.31	31	H24 H28	4 4	

H29 (Continued)

Rec	On	To	A	B	C	Db	Gp	Epoch	Time	Lrge	Med	Small	Total	N	Con-Rec	Coinec	Remarks
	Ja	Ja															
371	6	7	1	1	1	7	5	16:18	16	0.00	.06	3.56	3.62	32	H27 H25	- -	D, E.
371	6	7	1	1	1	7	5	16:46	-	-	-	-	-	33	H24 H28	- -	D, E, F.
371	6	7	1	1	1	7	5	17:14	16	0.00	0.00	2.00	2.00	34	H27 H25	- -	D, E.
371	6	7	1	1	1	7	5	17:46	16	0.00	0.00	1.19	1.19	35	H24 H28	- -	D, E.
371	6	7	1	1	1	7	5	18:14	16	0.00	0.00	1.75	1.75	36	H27 H25	- -	D, E.
371	6	7	1	1	1	7	5	18:46	16	0.00	.19	3.69	3.88	37	H24 H28	- -	D, E.
371	6	7	1	1	1	7	5	4:14	16	.19	2.25	65.69	68.13	38	H27 H25	- -	D, E, G.
371	6	7	1	1	1	7	5	4:48	15	.60	3.66	17.13	21.39	39	H24 H28	- -	D, E, H.
371	6	7	1	1	1	7	5	5:14	16	0.00	0.00	.69	.69	40	H27 H25	- -	D, E.
371	6	7	1	1	1	7	5	5:46	16	0.00	0.00	.49	.49	41	H24 H28	- -	D, E.
371	6	7	1	1	1	7	5	6:14	16	0.00	0.00	.81	.81	42	H27 H29	- -	D, E.
371	6	7	1	1	1	7	5	6:40	16	0.00	0.00	.94	.94	43	H24 H28	- -	D, E.
376	8	9	1	1	1	7	5	16:16	16	.94	4.81	18.75	24.50	56	H25 H28	7 7	I.
376	8	9	1	1	1	7	5	16:44	16	.56	3.19	12.81	16.56	57	H24 H28	9 9	
376	8	9	1	1	1	7	5	17:12	16	.50	2.75	9.94	13.19	58	H25 H28	6 6	
376	8	9	1	1	1	7	5	17:40	16	.56	1.87	10.94	13.37	59	H24 H28	4 5	
376	8	9	1	1	1	7	5	18:10	16	.37	2.69	10.25	13.31	60	H25 H28	9 9	
376	8	9	1	1	1	7	5	18:40	16	.69	2.25	9.87	12.81	61	H24 H28	6 7	
376	8	9	1	1	1	7	5	4:16	16	.75	1.94	10.00	12.69	62	H25 H28	3 3	
376	8	9	1	1	1	7	5	4:46	16	.94	1.50	10.94	13.38	63	H24 H28	4 4	
376	8	9	1	1	1	7	5	5:12	16	.75	2.69	9.62	13.06	64	H25 H28	5 5	
376	8	9	1	1	1	7	5	5:44	16	.69	1.69	10.06	12.44	65	H24 H28	3 4	
376	8	9	1	1	1	7	5	6:18	16	1.37	1.44	10.00	12.81	66	H25 H28	10 10	
376	8	9	1	1	1	7	5	6:48	16	.50	1.69	8.50	10.69	67	H24 H28	7 9	J.
379	9	11	1	1	1	7	5	16:13	16	5.75	22.37	49.12	77.24	68	H27 H25	16 -	K.
379	9	11	1	1	1	7	5	16:39	16	4.25	20.69	35.37	60.31	69	H24 H28	3 -	K.
379	9	11	1	1	1	7	5	17:09	16	4.56	15.94	40.12	60.62	70	H27 H25	8 -	K.
379	9	11	1	1	1	7	5	17:41	16	3.25	13.75	38.12	55.12	71	H24 H28	10 -	K.
379	9	11	1	1	1	7	5	18:09	16	3.75	10.50	36.06	50.31	72	H27 H25	9 -	K.
379	9	11	1	1	1	7	5	18:49	16	2.56	10.37	38.68	51.61	73	H24 H28	6 -	K.
379	9	11	1	1	1	7	5	4:08	16	2.44	6.06	19.81	28.31	74	H27 H25	4 -	K.
379	9	11	1	1	1	7	5	4:42	16	2.12	6.56	18.62	27.30	75	H24 H28	6 -	K.

H29 (Continued)

Rec	On	To	A	B	C	Db	Gp	Epoch	Time	Lrge	Med	Small	Total	N	Con-Rec	Coinc	Remarks
	Ja	Ja															
379	9	11	1	1	1	7	5	5:08	16	2.06	6.62	17.81	26.49	76	H27 H25	12	- K.
379	9	11	1	1	1	7	5	5:46	16	2.75	5.56	19.94	28.25	77	H24 H28	5	- K.
379	9	11	1	1	1	7	5	6:16	16	2.44	6.37	18.69	27.50	78	H27 H25	6	- K.
379	9	11	1	1	1	7	5	6:42	16	3.69	5.00	16.62	25.31	79	H24 H28	9	- K.
379	9	11	1	1	1	7	5	16:09	16	2.12	5.50	12.00	19.62	80	H27 H25	1	- K.
379	9	11	1	1	1	7	5	16:41	16	1.62	4.25	8.56	14.43	81	H24 H28	1	- K.
379	9	11	1	1	1	7	5	17:16	16	2.62	4.31	13.69	20.62	82	H27 H25	6	- K.
379	9	11	1	1	1	7	5	17:40	16	2.06	3.75	12.56	18.37	83	H24 H28	3	- K.
379	9	11	1	1	1	7	5	18:10	16	1.44	4.06	15.44	20.94	84	H27 H25	11	- K.
379	9	11	1	1	1	7	5	18:40	16	2.19	3.69	9.81	15.69	85	H24 H28	6	- K.
379	9	11	1	1	1	7	5	4:10	16	1.37	5.12	14.06	20.55	86	H27 H25	2	- K.
379	9	11	1	1	1	7	5	4:48	16	1.62	4.81	9.75	16.18	87	H24 H28	7	- K.
379	9	11	1	1	1	7	5	5:10	16	.56	3.06	13.12	16.74	88	H27 H25	5	- K.
379	9	11	1	1	1	7	5	5:46	16	1.56	3.94	11.81	17.31	89	H24 H28	2	- K, L.
379	9	11	1	1	1	7	5	6:14	16	1.12	3.37	11.87	16.36	90	H27 H25	3	- K.
379	9	11	1	1	1	7	5	6:46	16	2.00	2.87	11.37	16.24	91	H24 H28	1	- K.
382	11	12	1	1	1	7	5	16:41	16	4.62	9.00	34.12	47.74	93	H24 H28	5	5
382	11	12	1	1	1	7	5	17:41	16	2.75	8.50	24.81	36.06	95	H24 H28	3	3
382	11	12	1	1	1	7	5	18:41	16	2.56	6.68	21.18	30.42	97	H24 H28	5	5
382	11	12	1	1	1	7	5	4:42	16	3.69	5.69	13.87	23.25	99	H24 H28	6	8
382	11	12	1	1	1	7	5	5:44	16	3.06	3.56	12.12	18.74	101	H24 H28	10	11
382	11	12	1	1	1	7	5	6:42	-	-	-	-	-	103	H24 H28	-	- M.
383	12	13	1	1	1	7	5	16:15	28	9.18	12.61	10.93	32.72	104-5	H24 H28	11	13 N, O.
383	12	13	1	1	1	7	5	16:45	29	6.07	7.17	14.41	27.65	106-7	H27 H25	18	18 P.
383	12	13	1	1	1	7	5	17:15	29	4.41	4.72	12.00	21.13	108-9	H24 H28	7	8 P.
383	12	13	1	1	1	7	5	17:45	29	4.13	5.90	10.76	20.79	110-11	H27 H25	9	10 P.
383	12	13	1	1	1	7	5	18:15	29	4.69	6.96	14.48	26.13	112-13	H24 H28	4	4 P, Q.
383	12	13	1	1	1	7	5	18:45	-	-	-	-	-	114-15	H27 H25	2	4 P, R.
383	12	13	1	1	1	7	5	4:15	28	3.18	4.61	11.61	19.40	116-17	H24 H28	2	3 S.
383	12	13	1	1	1	7	5	4:44	28	2.43	4.53	11.28	18.24	118-19	H27 H25	1	1 T.
383	12	13	1	1	1	7	5	5:16	-	-	-	-	-	120-21	H24 H28	1	1 U.
383	12	13	1	1	1	7	5	5:44	-	-	-	-	-	122-23	H27 H25	-	- U.

H29 (Continued)

Rec	On	To	A	B	C	Db	Gp	Epoch	Time	Lrge	Med	Small	Total	N	Con-Rec	Coinc	Remarks
	Ja	Ja															
383	12	13	1	1	1	7	5	6:15	-	-	-	-	-	124-25	H24 H28	-	- U.
386	13	14	1	1	1	7	5	16:15	24	5.91	7.91	11.92	25.74	128-29	H24 H28	3	4 V.
386	13	14	1	1	1	7	5	17:17	24	5.12	8.62	11.33	25.07	132-33	H24 H28	4	6 V.
386	13	14	1	1	1	7	5	18:17	26.5	4.11	7.89	10.87	22.87	136-37	H24 H28	9	10 W.
386	13	14	1	1	1	7	5	4:12	10	2.00	23.00	33.70	58.70	140	H24 H28	5	0 V, X.
386	13	14	1	1	1	7	5	5:08	10	2.20	18.30	33.10	53.60	142	H24 H28	0	0 V.
386	13	14	1	1	1	7	5	6:16	10	2.60	16.90	26.30	45.80	144	H24 H28	0	0 V.
389	14	15	1	1	1	7	5	16:09	16	3.50	12.87	23.56	39.93	146	H24 H28	3	5
389	14	15	1	1	1	7	5	17:17	16	4.06	13.00	22.12	39.18	148	H24 H28	4	4
389	14	15	1	1	1	7	5	18:11	16	4.94	15.87	23.94	44.75	150	H24 H28	5	5
389	14	15	1	1	1	7	5	4:10	16	4.62	23.62	34.94	63.18	152	H24 H28	4	4
389	14	15	1	1	1	7	5	5:24	14	1.93	20.86	33.78	56.57	154	H24 H28	4	4
389	14	15	1	1	1	7	5	6:12	16	2.81	13.00	27.44	43.25	156	H24 H28	5	5
392	15	16	1	1	1	7	5	16:12	16	6.75	16.87	18.00	41.62	158	H24 H25	6	7 V.
392	15	16	1	1	1	7	5	17:12	16	4.25	10.31	17.00	31.56	160	H24 H25	3	3
392	15	16	1	1	1	7	5	18:18	16	6.12	12.56	19.37	38.05	162	H24 H25	7	7 Z.
392	15	16	1	1	1	7	5	4:12	16	3.06	10.12	26.44	39.62	164	H24 H25	8	10 A'.
392	15	16	1	1	1	7	5	5:18	16	2.50	9.56	16.37	28.43	166	H24 H25	3	4
392	15	16	1	1	1	7	5	6:12	16	2.12	7.56	14.50	24.18	168	H24 H25	14	14
395	16	18	1	1	1	7	5	16:12	2	8.00	65.00	100.00	173.00	170	H24 H25	6	6 B'.
395	16	18	1	1	1	7	5	17:11	16	4.81	26.94	38.69	70.44	172	H24 H25	8	8
395	16	18	1	1	1	7	5	18:17	16	3.87	15.12	31.75	50.74	174	H24 H25	7	9
395	16	18	1	1	1	7	5	4:18	16	3.44	7.75	21.25	32.44	176	H24 H25	11	11
395	16	18	1	1	1	7	5	5:12	16	2.75	8.31	22.44	33.50	178	H24 H25	7	7
395	16	18	1	1	1	7	5	6:20	16	2.37	6.56	21.25	30.18	180	H24 H25	6	6
395	16	18	1	1	1	7	5	16:25	16	1.87	4.75	13.94	20.56	182	H24 H25	2	2
395	16	18	1	1	1	7	5	17:16	16	1.75	6.25	15.81	23.81	184	H24 H25	1	1
395	16	18	1	1	1	7	5	18:18	16	2.06	6.94	18.37	27.37	186	H24 H25	2	3
395	16	18	1	1	1	7	5	4:14	16	1.44	4.75	17.12	23.31	188	H24 H25	3	3
395	16	18	1	1	1	7	5	5:12	16	.94	6.44	15.31	22.69	190	H24 H25	0	0
395	16	18	1	1	1	7	5	6:14	16	.75	4.31	20.00	25.06	192	H24 H25	4	4
398	18	19	1	1	1	7	5	16:13	16	6.37	22.25	40.31	68.93	194	H24 H28	3	3 C'.

H29 (Continued)

Rec	On	To	A	B	C	Db	Gp	Epoch	Time	Lrge	Med	Small	Total	N	Con-Rec	Coinc	Remarks
	Ja	Ja															
398	18	19	1	1	1	7	5	17:19	16	4.00	10.56	28.75	43.31	196	H24 H28	6 6	
398	18	19	1	1	1	7	5	18:16	16	3.31	9.81	28.75	41.87	198	H24 H28	1 1	
398	18	19	1	1	1	7	5	4:14	16	1.62	7.56	17.62	26.80	200	H24 H28	0 1	
398	18	19	1	1	1	7	5	5:14	16	1.87	6.00	12.87	20.74	202	H24 H28	0 0	
398	18	19	1	1	1	7	5	6:24	12	2.08	6.50	15.83	24.41	204	H24 H28	2 2	
401	19	20	1	1	1	7	5	16:13	16	2.31	8.00	14.56	24.87	206	H24 H28	11 14	
401	19	20	1	1	1	7	5	17:11	16	3.31	5.94	14.25	23.50	208	H24 H28	8 10	
401	19	20	1	1	1	7	5	18:13	16	2.50	5.87	17.75	26.12	210	H24 H28	5 5	
401	19	20	1	1	1	7	5	4:16	16	2.06	6.19	13.06	21.31	212	H24 H28	4 4	D'.
401	19	20	1	1	1	7	5	5:14	16	1.69	6.44	14.94	23.07	214	H24 H28	1 0	
401	19	20	1	1	1	7	5	6:12	16	1.44	6.69	12.19	20.32	216	H24 H28	4 5	
404	20	21	1	1	1	7	5	16:17	16	1.00	1.62	3.19	5.81	218	H24 H28	13 13	E'.
404	20	21	1	1	1	7	5	17:15	16	1.75	6.06	19.87	27.68	220	H24 H28	11 13	
404	20	21	1	1	1	7	5	18:15	16	1.50	5.87	17.69	25.06	222	H24 H28	8 11	
404	20	21	1	1	1	7	5	4:18	16	1.81	5.69	18.37	25.87	224	H24 H28	5 7	
404	20	21	1	1	1	7	5	5:12	16	2.06	5.25	15.00	22.31	226	H24 H28	2 3	
404	20	21	1	1	1	7	5	6:14	16	2.25	4.94	14.25	21.44	228	H24 H28	2 2	
407	21	22	1	1	1	7	5	16:15	16	2.75	45.12	65.81	113.68	230	H24 H28	4 4	
407	21	22	1	1	1	7	5	17:21	16	1.31	10.50	36.19	48.00	232	H24 H28	5 6	
407	21	22	1	1	1	7	5	18:15	16	1.87	6.62	32.62	41.11	234	H24 H28	4 5	
407	21	22	1	1	1	7	5	4:16	16	3.75	8.25	21.19	33.19	236	H24 H28	7 9	F'.
407	21	22	1	1	1	7	5	5:14	16	3.62	6.62	19.94	30.18	238	H24 H28	9 13	G'.
407	21	22	1	1	1	7	5	6:14	16	2.44	5.00	15.50	22.94	240	H24 H28	4 4	
410	22	23	1	1	1	7	5	16:21	16	1.06	7.19	38.81	47.06	242	H24 H28	2 2	
410	22	23	1	1	1	7	5	17:17	16	1.12	5.19	29.19	35.50	244	H24 H28	1 4	
410	22	23	1	1	1	7	5	18:17	16	1.12	3.31	23.81	28.24	246	H24 H28	3 4	
410	22	23	1	1	1	7	5	4:15	16	2.19	4.81	24.06	31.06	248	H24 H28	1 1	
410	22	23	1	1	1	7	5	5:15	16	2.06	4.06	19.37	25.49	250	H24 H28	3 3	
410	22	23	1	1	1	7	5	6:15	16	2.75	4.75	18.06	25.56	252	H24 H28	6 6	
413	23	25	1	1	1	7	5	16:15	16	1.62	5.06	23.06	29.74	254	H24 H28	1 1	
413	23	25	1	1	1	7	5	17:15	16	1.06	4.37	16.50	21.93	256	H24 H28	3 4	
413	23	25	1	1	1	7	5	18:15	16	1.37	4.25	16.94	21.56	258	H24 H28	1 2	H'.

H29 (Continued)

Rec	On	To	A	B	C	Db	Gp	Epoch	Time	Lrge	Med	Small	Total	N	Con-Rec	Coinc	Remarks
	Ja	Ja															
413	23	25	1	1	1	7	5	4:17	16	3.75	5.19	13.44	22.38	260	H24	H28	2 5
413	23	25	1	1	1	7	5	5:19	16	2.69	4.87	13.50	21.06	262	H24	H28	5 5
413	23	25	1	1	1	7	5	6:17	16	2.87	4.56	11.56	18.99	264	H24	H28	8 8
413	23	25	1	1	1	7	5	<u>16:17</u>	16	1.44	3.44	9.50	14.38	266	H24	H28	2 3
413	23	25	1	1	1	7	5	<u>17:17</u>	16	1.12	4.31	11.25	16.68	268	H24	H28	3 4
413	23	25	1	1	1	7	5	<u>18:19</u>	16	1.81	3.81	11.25	16.87	270	H24	H28	8 11
413	23	25	1	1	1	7	5	<u>4:19</u>	16	1.00	3.62	9.75	14.37	272	H24	H28	1 1
413	23	25	1	1	1	7	5	<u>5:21</u>	16	1.12	3.69	10.00	14.81	274	H24	H28	3 3
413	23	25	1	1	1	7	5	<u>6:21</u>	16	1.00	3.93	9.87	14.80	276	H24	H28	3 3
416	25	26	1	1	1	7	5	<u>16:19</u>	16	1.56	3.37	10.44	15.37	278	H24	H28	4 4
416	25	26	1	1	1	7	5	17:23	16	2.00	4.75	11.44	18.19	280	H24	H28	2 2 I'.
416	25	26	1	1	1	7	5	18:17	16	1.12	2.94	9.00	13.06	282	H24	H28	3 4
416	25	26	1	1	1	7	5	4:17	16	.62	2.75	8.75	12.12	284	H24	H28	2 3
416	25	26	1	1	1	7	5	5:17	16	.75	2.50	8.87	12.12	286	H24	H28	2 3
416	25	26	1	1	1	7	5	6:17	16	1.12	3.62	19.44	24.18	288	H24	H28	4 5
419	26	27	1	1	1	7	5	16:21	16	.62	2.94	15.25	18.81	290	H24	H28	4 4 J'.
419	26	27	1	1	1	7	5	17:17	16	.94	2.81	10.06	13.81	292	H24	H28	3 3
419	26	27	1	1	1	7	5	18:17	16	.75	2.25	10.06	13.06	294	H24	H28	4 5
419	26	27	1	1	1	7	5	4:21	16	.37	2.69	19.87	22.93	296	H24	H28	1 1
419	26	27	1	1	1	7	5	5:17	16	.81	2.31	10.56	13.68	298	H24	H28	3 5
419	26	27	1	1	1	7	5	6:23	16	.75	2.00	10.00	12.75	300	H24	H28	0 0
422	27	28	1	1	1	7	5	16:17	16	3.44	5.50	12.06	21.00	302	H24	H28	26 45
422	27	28	1	1	1	7	5	17:17	16	1.69	4.06	8.62	14.37	304	H24	H28	0 0
422	27	28	1	1	1	7	5	18:17	16	1.62	3.62	11.12	16.36	306	H24	H28	5 6
422	27	28	1	1	1	7	5	4:17	16	1.00	2.75	12.50	16.25	308	H24	H28	0 3
422	27	28	1	1	1	7	5	5:17	16	.69	3.06	9.00	12.75	310	H24	H28	6 7
422	27	28	1	1	1	7	5	6:21	16	1.94	4.69	12.06	18.69	312	H24	H28	9 9

Remarks H29

- A. Entire record was useless due to open circuit.
- B. Entire record was useless due to open circuit.
- C. Coincidences between record 368(H29) and the other concurrent records 367(H27) and 366(H25) are difficult to determine owing to extremely active conditions on 3801W9.
- D. A most peculiar record, almost quiescent except for salvos of short duration - about a minute. On Jan. 8 found bad contacts at amphenol coupling. No listening done on 3801W9 today. Geophone was reset yesterday and only put in about 12'. Stylus voltage too high throughout record.
- E. New schedule begun, 4-7 in half hour runs.
- F. Omitting salvos the count was 6 small in 10 min. or 0.60. This is so little use it is not tabulated.
- G. Beginning at 4 a.m. Jan. 7 the character of the record changed to almost continuous small offsets. They are not "static" and seem real. They, of course, follow blasting.
- H. A heavy salvo omitted from the count. They are very numerous on this record 371(H29).
- I. The geophone was reset to a full depth of 30'. Record 371(H29) for Jan. 6-7 was poor, largely because of poor contacts at amphenol coupling. The hole was reamed on Jan. 7 to permit the geophone to be reset to full depth.
- J. Voltage too high on stylus. Centre broken toward end of record.
- K. Record 377(H28, H25) (Jan. 9-11) useless due to mistake in setting attenuator after modifications to recorder.
- L. Stylus voltage too high toward end of record.
- M. Record 382(H29) having time switch trouble this part of the run.
- N. The first section of this record completely analysed into 9 classes.
- O. Salvos of small intensity merged in the records appear on page 38302. One of these was disregarded in the count.

Remarks H29 (Continued)

- P. Coincidences checked out by E.A.H. from record books as there had been an error in comparing records.
- Q. Short salvo at 6-03 p.m. Jan. 12. See page 38313A.
- R. Record 383(H29) turned off at 6-45 p.m. Jan. 12 by accidental change in setting of program clock.
- S. Record fails to show traces of the salvos shown on record 385(H24) and 384(H28).
- T. See Note U for H25.
- U. Record ran only 14 min. when it was turned off by accidental change in setting of program clock. The coincidences with 385(H24) and 384(H28) are thus for 15 min. only. From 5-15 a.m. Jan. 13 to end of the run the coincidences are all out and the count for the two geophones are mixed and are here omitted. They could be deduced for 14 min. intervals if care were taken since some coincidences do exist to identify the times on this record.
- V. Time switch gave trouble leading to a somewhat shortened record for some runs during the 24 hrs. and quite spoiling some others. Note E.G. began checking totals and coincidences at the beginning of this record continuing to the end of the report.
- W. A burst registered on record 386(H29) beginning just before 7 p.m. Jan. 13. See page 38618A. This burst registered as a single offset on F27 and H25. See pages 38818A and 38718A (marked N on records).
- X. See Note S for H24.
- Y. See Note T for H24.
- Z. Record shows bunching of offsets quite markedly.
- A'. A rather long and open salvo began about 4-13 a.m. Jan. 16 and continued for about 5 min. It was marked by a wide zero with much small activity on H24, by discrete offsets of all types on H25 and by a slightly wider zero with activity both large, medium, and small on H29. Compare pages 39419, 39319, and 39219 seq.

Another short salvo appears on H24 at about 4-27 and continues for 2 min. It shows heavy snaps on H25 and heavy snaps but fewer on H29. Compare pages 39421A, 39321A, and 39221A.

Remarks H29 (Continued)

- B'. This activity so great only 2 min. counted. The coincidences with H29 were however checked over for 16 min.
- C'. Small salvo beginning about 4-06 p.m. Jan. 18 on H29. No trace on H24 or H28. Compare pages 40002A, 39902A, and 39802A at point marked X.
- D'. See Note S for H28 regarding a short salvo at 4-17 a.m. Jan. 20 which was well marked on H28 and H24. There was practically no trace on H29 at that time but there were many very small salvos on H29 during the run 4-4:30. One of these appears about 4-19 with two others on page 40120B immediately following. These are represented on H28 and H24 by sharp single snaps.
- E'. Between 4-05 and 4-07 p.m. Jan. 20, a series of what look like blasts recorded on H28 but not on H24 or H29 which ran concurrently. A short burst recorded on H29 at 4-06 but no trace of it except as a single snap appears on H24 or H28. Compare pages 40602A, 40502A, and 40402A.
- F'. See Note X for H28.
- G'. Snaps come in little groups which almost become small bursts. See page 40725B at point marked M.
- H'. Stylus voltage too high.
- I'. Rather ill defined salvo, lasting about a minute, began 5-24 p.m. Jan. 25 on H29. No trace on H24 or H28. See pages 41809A, 41709A, and 41609A.
- J'. See Note D' for H28.

H31

Rec	On	To	A	B	C	Db	Gp	Epoch	Time	Lrge	Med	Small	Total	N	Con-Rec	Coinc	Remarks
	Ja	Ja															
382	11	12	1	1	1	7	5	16:19	-	-	-	-	-	92	H27 H25	- -	A.
382	11	12	1	1	1	7	5	17:15	-	-	-	-	-	94	H27 H25	- -	A.
382	11	12	1	1	1	7	5	18:11	-	-	-	-	-	96	H27 H25	- -	A.
382	11	12	1	1	1	7	5	4:12	-	-	-	-	-	98	H27 H25	- -	A, B.
382	11	12	1	1	1	7	5	5:16	-	-	-	-	-	100	H27 H25	- -	A, C.
382	11	12	1	1	1	7	5	6:18	12	1.58	6.75	32.75	41.08	102	H27 H25	4 4	D.
386	13	14	1	1	1	7	5	16:46	24	1.04	4.21	9.08	14.33	130-31	H27 H25	11 10	E.
386	13	14	1	1	1	7	5	17:47	-	-	-	-	-	134-35	H27 H25	- -	E.
386	13	14	1	1	1	7	5	18:47	-	-	-	-	-	138-39	H27 H25	- -	E.
386	13	14	1	1	1	7	5	4:48	-	-	-	-	-	141	H27 H25	- -	E, F.
386	13	14	1	1	1	7	5	5:57	-	-	-	-	-	143	H27 H25	- -	E.
386	13	14	1	1	1	7	5	6:40	-	-	-	-	-	145	H27 H25	- -	E.
389	14	15	1	1	1	7	5	16:41	-	-	-	-	-	147	H27 H25	- -	G, H.
389	14	15	1	1	1	7	5	17:51	-	-	-	-	-	149	H27 H25	- -	G.
389	14	15	1	1	1	7	5	18:47	-	-	-	-	-	151	H27 H25	- -	G.
389	14	15	1	1	1	7	5	4:42	-	-	-	-	-	153	H27 H25	- -	G, I.
389	14	15	1	1	1	7	5	5:42	-	-	-	-	-	155	H27 H25	- -	G.
389	14	15	1	1	1	7	5	6:50	16	.56	4.12	10.37	15.05	157	H27 H25	1 3	
392	15	16	1	1	1	7	5	16:52	16	1.00	3.94	6.37	11.31	159	H27 H25	14 14	
392	15	16	1	1	1	7	5	17:42	16	.56	3.56	6.69	10.81	161	H27 H25	8 8	
392	15	16	1	1	1	7	5	18:42	16	.25	3.75	11.25	15.25	163	H27 H25	3 4	
392	15	16	1	1	1	7	5	4:40	16	.56	8.69	15.19	24.44	165	H27 H25	12 13	
392	15	16	1	1	1	7	5	5:46	16	.06	6.62	9.25	15.93	167	H27 H25	9 9	
392	15	16	1	1	1	7	5	6:42	16	.37	5.25	10.44	16.06	169	H27 H25	11 11	
395	16	18	1	1	1	7	1	16:40	16	.75	5.31	12.87	18.93	171	H27 H25	9 9	
395	16	18	1	1	1	7	1	17:41	16	.44	.75	4.69	5.88	173	H27 H25	8 8	
395	16	18	1	1	1	7	1	18:41	16	.37	5.19	29.00	34.56	175	H27 H25	6 7	
395	16	18	1	1	1	7	1	4:40	16	.31	10.31	15.37	25.99	177	H27 H25	3 3	
395	16	18	1	1	1	7	1	5:42	16	.62	8.81	12.93	22.36	179	H27 H25	11 12	
395	16	18	1	1	1	7	1	6:46	16	.50	7.25	12.87	20.62	181	H27 H25	8 8	
395	16	18	1	1	1	7	1	16:50	16	.69	6.12	40.81	47.62	183	H27 H25	3 3	
395	16	18	1	1	1	7	1	<u>17:46</u>	16	.19	4.75	34.69	39.63	185	H27 H25	0 1	

H31 (Continued)

Rec	On	To	A	B	C	Db	Gp	Epoch	Time	Lrge	Med	Small	Total	N	Con-Rec	Coinc	Remarks
	Ja	Ja															
395	16	18	1	1	1	7	1	18:48	16	.12	6.75	43.62	50.49	187	H27 H25	6 6	
395	16	18	1	1	1	7	1	4:44	16	.31	17.50	60.87	78.68	189	H27 H25	2 2	J.
395	16	18	1	1	1	7	1	5:31	2	9.00	43.00	93.00	145.00	191	H27 H25	0 0	K.
395	16	18	1	1	1	7	1	6:41	2	4.00	35.00	88.00	127.00	193	H27 H25	0 0	
398	18	19	1	1	1	7	1	16:45	16	1.25	4.69	15.19	21.13	195	H27 H25	13 12	
398	18	19	1	1	1	7	1	17:43	16	1.19	4.06	12.19	17.44	197	H27 H25	9 9	
398	18	19	1	1	1	7	1	18:42	16	.37	5.87	16.50	22.74	199	H27 H25	5 3	
398	18	19	1	1	1	7	1	4:42	16	.81	11.56	27.62	39.99	201	H27 H25	2 2	
398	18	19	1	1	1	7	1	5:42	16	.62	10.62	22.06	33.30	203	H27 H25	1 1	
398	18	19	1	1	1	7	1	6:42	16	.31	15.19	38.62	54.62	205	H27 H25	1 1	
401	19	20	1	1	1	7	1	16:41	16	2.12	3.75	8.62	14.49	207	H27 H25	14 14	L.
401	19	20	1	1	1	7	1	17:43	16	1.81	3.31	6.87	11.99	209	H27 H25	13 13	
401	19	20	1	1	1	7	1	18:41	16	.81	2.87	6.31	9.99	211	H27 H25	10 10	
401	19	20	1	1	1	7	1	4:42	16	.75	3.44	17.87	22.06	213	H27 H25	8 8	
401	19	20	1	1	1	7	1	5:44	16	.44	3.12	9.87	13.43	215	H27 H25	6 6	
401	19	20	1	1	1	7	1	6:44	16	.37	2.69	8.75	11.81	217	H27 H25	7 7	
404	20	21	1	1	1	7	1	16:43	16	.62	2.44	8.50	11.56	219	H27 H25	10 11	
404	20	21	1	1	1	7	1	17:43	16	.69	2.12	6.44	9.25	221	H27 H25	8 10	
404	20	21	1	1	1	7	1	18:47	16	.62	2.50	6.31	9.43	223	H27 H25	9 13	
404	20	21	1	1	1	7	1	4:46	16	1.06	3.62	11.94	16.62	225	H27 H25	11 11	
404	20	21	1	1	1	7	1	5:44	16	1.25	3.19	8.87	13.31	227	H27 H25	14 16	
404	20	21	1	1	1	7	1	6:44	16	1.25	4.19	8.75	14.19	229	H27 H25	9 11	
407	21	22	1	1	1	7	1	16:43	16	1.81	3.31	8.06	13.18	231	H27 H25	17 19	
407	21	22	1	1	1	7	1	17:43	16	.87	1.87	8.81	11.55	233	H27 H25	10 12	
407	21	22	1	1	1	7	1	18:43	16	.56	2.62	8.94	12.12	235	H27 H25	9 10	
407	21	22	1	1	1	7	1	4:42	16	2.25	4.25	20.19	26.69	237	H27 H25	11 11	
407	21	22	1	1	1	7	1	5:44	16	1.50	2.06	12.44	16.00	239	H27 H25	9 13	
407	21	22	1	1	1	7	1	6:44	16	.94	3.37	11.25	15.56	241	H27 H25	5 5	
410	22	23	1	1	1	7	1	16:47	16	1.25	3.25	10.56	15.56	243	H27 H25	19 24	
410	22	23	1	1	1	7	1	17:47	16	1.37	3.50	9.31	14.18	245	H27 H25	6 6	
410	22	23	1	1	1	7	1	18:47	16	1.06	2.44	9.69	13.19	247	H27 H25	12 12	
410	22	23	1	1	1	7	1	4:47	16	1.87	3.94	24.31	30.12	249	H27 H25	8 8	

H31 (Continued)

Rec	On	To	A	B	C	Db	Gp	Epoch	Time	Lrge	Med	Small	Total	N	Con-Rec	Coinc	Remarks
	Ja	Ja															
410	22	23	1	1	1	7	1	5:47	16	1.44	2.62	17.12	21.18	251	H27 H25	11 13	
410	22	23	1	1	1	7	1	6:47	16	1.44	3.94	18.44	23.82	253	H27 H25	11 13	
413	23	25	1	1	1	7	1	16:43	16	1.69	3.69	11.37	16.75	255	H27 H25	10 10	
413	23	25	1	1	1	7	1	17:43	16	1.25	3.00	11.06	15.31	257	H27 H25	7 10	
413	23	25	1	1	1	7	1	18:43	16	1.00	3.56	13.12	21.68	259	H27 H25	11 13	
413	23	25	1	1	1	7	1	4:45	16	1.62	6.75	25.12	33.49	261	H27 H25	8 8	M.
413	23	25	1	1	1	7	1	5:45	16	1.37	3.44	18.87	23.68	263	H27 H25	8 9	
413	23	25	1	1	1	7	1	6:45	16	1.81	3.75	9.37	14.93	265	H27 H25	10 11	
413	23	25	1	1	1	7	1	16:49	16	1.06	3.31	8.75	13.12	267	H27 H25	9 9	
413	23	25	1	1	1	7	1	17:49	-	-	-	-	-	269	H27 H25	- -	N.
413	23	25	1	1	1	7	1	18:45	16	1.25	3.81	29.00	34.06	271	H27 H25	4 4	O.
413	23	25	1	1	1	7	1	4:45	16	1.12	4.12	37.44	42.68	273	H27 H25	- -	P.
413	23	25	1	1	1	7	1	5:45	-	-	-	-	-	275	H27 H25	- -	P.
413	23	25	1	1	1	7	1	6:51	16	1.31	3.12	67.37	71.80	277	H27 H25	6 7	Q.
416	25	26	1	1	1	7	1	16:49	16	1.50	6.56	35.50	43.56	279	H27 H25	3 3	
416	25	26	1	1	1	7	1	17:47	16	1.04	4.94	34.75	40.69	281	H27 H25	11 14	
416	25	26	1	1	1	7	1	18:45	16	.94	4.44	30.37	35.75	283	H27 H25	10 17	
416	25	26	1	1	1	7	1	4:51	16	.69	5.94	49.56	56.19	285	H27 H25	0 1	R.
416	25	26	1	1	1	7	1	5:53	16	1.19	4.62	43.75	49.56	287	H27 H25	0 1	
416	25	26	1	1	1	7	1	6:49	16	.56	5.56	70.44	76.56	289	H27 H25	1 1	
419	26	27	1	1	1	7	1	16:47	16	.81	5.19	47.31	53.31	291	H27 H25	12 13	S.
419	26	27	1	1	1	7	1	17:45	16	1.25	3.19	41.81	46.25	293	H27 H25	14 14	
419	26	27	1	1	1	7	1	18:45	16	1.19	4.19	47.37	52.75	295	H27 H25	9 11	T.
419	26	27	1	1	1	7	1	4:47	16	1.69	11.69	84.06	97.44	297	H27 H25	1 2	
419	26	27	1	1	1	7	1	5:53	16	.94	12.06	76.12	89.12	299	H27 H25	0 0	
419	26	27	1	1	1	7	1	6:51	16	1.00	13.25	73.50	87.75	301	H27 H25	0 0	
422	27	28	1	1	1	7	1	16:45	2	4.50	40.50	92.00	137.00	303	H27 H25	5 5	U.
422	27	28	1	1	1	7	1	17:49	16	2.25	33.68	60.50	96.43	305	H27 H25	4 4	
422	27	28	1	1	1	7	1	18:47	16	1.62	26.00	56.87	84.49	307	H27 H25	1 1	
422	27	28	1	1	1	7	1	4:47	16	1.50	16.25	51.31	69.06	309	H27 H25	5 5	
422	27	28	1	1	1	7	1	5:44	14	.50	18.50	44.78	63.78	311	H27 H25	4 4	V.
422	27	28	1	1	1	7	1	6:45	16	2.44	16.50	38.94	57.88	313	H27 H25	10 10	W.

Remarks H31

- A. First record on 3801W9 with two geophones (H29, H31). Time switch spoiled much of the record. Voltage was too high also on styl1.
- B. Long salvo beginning 4-10 and lasting 4 min. followed by another beginning 4-16 and lasting 4 min. +, running into time switch change. Some traces of these on record 381(H27) and record 380 (H25) but not nearly as much as on this record 382(H31).
- C. See Note P for record 380(H25).
- D. Time switch worked all right till 4 min. before the end of the comparison run. Thus coincidences with record 381(H27) and record 380(H25) are for 12 min. only.
- E. Time switch gave some trouble leading to a somewhat shorter record for some runs for the 24 hrs. and totally spoiling some others. NOTE: Began reading for shorter periods due to pressure of work.
- F. See Note Z for H25.
- G. Time switch gave trouble on H31.
- H. What may have been a burst shows only on 389(H31)? just about the time the switch changed. No trace on other records. See page 38904.
- I. What may have been a burst shows only on 389(H31). Does not appear on other records. Began about 4-42 a.m. Jan. 15 and lasted 3 min. See page 38922B.
- J. A slight trace of a salvo at 4-38 a.m. Jan. 18 appears on H31 only. No trace on H27 or H25. See page 39556A.
- K. So active that only 2 min. were read (by E.A.H. Apr. 14). Sudden sharp increase on a Monday morning when no work was done since early Sunday morning. Compare pages 39556A (4-32 a.m. Jan. 18); 39561B (5-32 a.m. Jan. 18); 39567A (6-32 a.m. Jan. 18).
- L. A short salvo of strong offsets lasting less than a minute occurred at 4-40 p.m. Jan. 19. It was well marked on H27, H25 and H31. Compare pages 40305A, 40205A, and 40105A.
- M. A series of faintly developed salvos lasting each about a minute began about 4-47 a.m. Jan. 24 on H31. They did not appear on H27 or H25 until about 4-57 when they were faintly developed also on H25. Compare pages 41522, 41422, and 41322 seq. to 41524, 41424, and 41324.

Remarks H31 (Continued)

- N. Poor contact on time switch. Zero very wide.
- O. Stylus voltage too high.
- P. Poor contact on time switch. Record hardly legible.
- Q. This high count must be taken with reserve. The time switch contacts were very poor.
- R. Some evidence of ore skipping on this record. See page 41624A and compare with 41824.
- S. See Note M' for H25.
- T. See Note N' for H25.
- U. A small section of H31 came on record 422 on the first page. It lasted only 2 min. before being stopped by the time switch, but the activity recorded was of extraordinary energy. Coincidences with H27 and H25 checked only for 2 min.
- V. A small sharp burst occurred at 5-49 a.m. Jan. 28. It registered for about 2 min. on each record (H27, H25, H31). It was most sharply marked on H25 but there were many more small ones registered on H31. The larger snaps in the burst were as well marked on H27 as on H25. Compare pages 42428, 42328, and 42228.
- W. The set 111 with the records 425(H29, H31) were lost in the burst of Jan. 29 which closed the drift 3801W for more than 300'.

APPENDIX III

Salvos and Bursts Registered - January, 1943

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In the following tabulation, the successive headings indicate:

- No = Serial number assigned to the disturbance.
- Ja = The January date.
- T = Type, Burst or Salvo.
- Began = Nearest minute when the disturbance started given in Eastern War Time on the 24 hr. system beginning at midnight.
- Dur. = The duration, to the nearest half minute.
- Con.Rec. = The concurrent records running at the time of the disturbance.
- Con.Rec.-Pages = Page of the record where the disturbance registered (Inserted for convenience of reference of operators only).
- Inten = The estimated intensity on an ascending scale of 5.
- Rem = A series of remarks following the table.

No	Ja	T	Began	Dur.	Concur.	Rec.	Concur.	Rec.	-Pages	Inten	Rem.
1	5	S	4:39	2.	H29	H28	H24	36516	36316	36416	- 3 3
2	6	S	16:11	0.5	F29	H28	H24	37102	36902	37002	1 - - A.
3	"	S	16:13	1.0	"	"	"	37102	36902	37002	1 - - "
4	"	S	16:15	1.0	"	"	"	37102	36902	37002	2 - - "
5	"	S	16:22	2.0	"	"	"	37103	36903	37003	2 - - "
6	"	S	16:40	4.0	"	"	"	37105	36905	37005	2 - - "
7	8	S	4:16	4.0	H27	H25	-	37319	37219	-	- 3 - B, C.
8	"	S	4:22	2.0	"	"	-	37320	37220	-	- 3 - "
9	"	S	4:28	2.0	"	"	-	37321	37221	-	- 2 - "
10	9	S	4:16	4.0	H29	H25	H28	37619	37520	37419	0 2 3 C.
11	"	S	4:22	2.5	"	"	"	37620	37520	37420	0 2 3 C.
12	"	S	4:30	7.0	"	"	"	37621	37521	37421	0 ? 4 D.
13	12	S	5:02	5.0	H31	H28	H24	38224	38024	38124	- 3 - E.
14	"	S	5:12	6.0	"	"	"	38225	38025	38125	- 4 - "
15	"	B	16:08	1.0	H29	H28	H24	38302	38402	38502	2 1 1 F.
16	"	B	16:10	1.0	"	"	"	38302	38402	39502	3 1 1 "
17	"	S	18:37	0.5	H29	H27	H25	38316	38516	38416	0 0 2
18	13	S	4:04	2.0	H29	H28	H24	38317	38418	38519	0 3 2
19	"	S	4:13	2.0	"	"	"	38318	38419	38519	0 3 2
20	"	S	4:23	5.0	"	"	"	38319	38420	38520	0 3 2
21	"	S	4:50	0.5	H29	H27	H25	38322	38523	38423	1 2 0
22	"	S	5:41	1.0	H29	H27	H25	38325	38528	38427	0 0 2
23	"	B	18:59	1.5	H29	H27	H25	38618	38818	38718	3 1 1 G.
24	14	B	4:20	0.5	H29	H28	H24	38620	38720	38820	1 2 2 H.
25	"	S	4:25	1.0	F29	H28	H24	38620	38720	38821	1 3 2
26	"	B	4:33	10.0	H31	H27	H25	38621	38821	38721	0 2 5 I.
27	"	S	4:55	1.0	H31	H27	H25	38623	38823	38723	0 0 2
28	"	S	4:57	1.0	"	"	"	38623	38823	38723	0 0 1
29	"	S	16:30	4.5	H31	H27	H25	38904	39104	39004	4 - 0 J.
30	15	S	4:42	3.5	H31	H27	H25	38922	39122	39022	3 0 0
31	"	B	16:13	0.5	H29	H25	H24	39202	39302	39402	3 5 5 K.
32	16	S	4:13	4.5	H29	H25	H24	39219	39319	39419	4 3 2
33	"	S	4:27	1.5	H29	H25	H24	39221	39321	39421	3 4 4
34	18	S	4:38	1.0	H31	H27	H25	39556	39756	39656	2 0 0
35	"	S	16:06	1.0	H29	H28	H24	39802	39902	40002	2 0 0
36	19	S	16:40	0.5	H31	H27	H25	40105	40305	40205	3 5 5 K.
37	20	S	4:18	0.5	H29	H28	H24	40120	40220	40320	2 2 2 L.
38	"	S	5:25	1.0	H29	H28	H24	40126	40226	40326	1 1 1
39	"	S	16:06	0.5	H29	H28	H24	40402	40502	40602	3 2 2 M.
40	21	S	4:07	0.5	H29	H28	H24	40419	40519	40619	0 2 2
41	"	S	4:46	0.5	H31	H27	H25	40422	40623	40522	1 1 2
42	"	B	16:03	0.5	H29	H28	H24	40701	40801	40901	2 3 3 N.
43	"	S	16:28	2.0	H29	H28	H24	40704	40804	40904	1 4 3 O.
44	22	S	4:26	2.0	H29	H28	H24	40721	40821	40921	1 5 3
45	"	S	5:16	0.5	H29	H28	H24	40725	40825	40925	2 1 0
46	"	S	16:13	0.5	H29	H28	H24	41002	41102	41202	0 4 3
47	"	S	16:47	0.5	H31	H27	H25	41005	41205	41105	0 0 2
48	23	S	5:32	0.5	F29	H28	H24	41027	41126	41227	1 3 2

No Ja T Began Dur. Concur.Rec. Concur.Rec.-Pages Inten Rem.

49	24	S	4:23	0.5	H29	H28	H24	41320	41420	41520	1	3	2	P.
50	"	S	4:47	2.0	H31	F27	H25	41322	41522	41422	2	0	0	Q.
51	25	S	17:24	1.0	H29	F28	H24	41609	41709	41809	2	0	0	
52	26	S	4:12	4.0	H29	H28	H24	41619	41719	41819	2	4	2	R.
53	"	S	4:19	0.5	H29	F28	H24	41620	41720	41820	1	3	0	
54	"	S	4:25	7.0	H29	H28	F24	41620	41720	41821	2	4	2	S.
55	"	S	16:37	0.5	H31	H27	H25	41904	42104	42004	5	5	5	
56	27	S	4:00	4.0	H31	H27	H25	41918	42118	42017	3	3	4	T.
57	"	S	4:13	4.0	H29	H28	H24	41919	42018	42119	2	4	1	U.
58	28	S	4:14	2.0	H29	H28	H24	42219	42319	42419	2	4	1	V.
59	"	B	5:49	4.0	H31	H27	H25	42228	42428	42328	5	3	4	
60	"	S	16:06	0.5	-	H25	H24	-	42601	42701	-	5	5	W.
61	"	S	16:19	0.5	-	H25	H24	-	42603	42703	-	4	4	W.

Remarks

- A. May not be seismic. No trace on concurrent records. H29 was not recording snaps at this time but these salvos (?) were recorded.
- B. Only H27 and H25 recording at the time of these salvos and H27 was spoiled by bad contacts on the time switch.
- C. May not be seismic but no other cause known. Set was working well on H25. But compare Nos. 7, 8, and 9 with Nos. 10, 11, and 12. Sets working well on H25 and H28 for the latter three salvos. It seems strange that there should be such a close agreement in time for the two successive days.
- D. Time switch changed H25 to H24 and interfered considerably with the record. The salvo began to record on H25 and continued to do so on H24 being less in each case than H28.
- E. Switch trouble interfered with both H31 and H24.
- F. These bursts registered with many closely recorded offsets on H29 but only the initial strong burst and a few strong succeeding snaps registered on H28 and H24.
- G. Strong burst with closely registered snaps on H29. Initial snap only on H27 and H24.
- H. Small initial snap on F29 and some closely recorded smaller snaps. Larger initial snaps and one large succeeding snap on F28 and H24.

Remarks (Continued)

- I. There seems to be nothing the matter with H31 record but there is no trace of this burst of such outstanding magnitude on H25.
- J. A series of salvos on H31 just as switch changed. No trace on H25. H27 was having time switch trouble. May not be seismic.
- K. A short series of all strong snaps, beginning and ending abruptly.
- L. A short salvo just prior to 4-18 a.m. registered on H28 and H24 but not on H29. Shortly after 4-18 a short salvo registered on H29 with no registration on H28 or H24 except two snaps. During this entire record H29 registration tended to run in groups.
- M. A short salvo registered on H29 with nothing but the larger snaps showing on H28 or H24. But on H28 there were a series of what look like blasts - at a time when blasting does not occur - which register hardly at all on H29 and only slightly more on H24. It is not known what this disturbance was but it seems surely to have been seismic. See Note N.
- N. Two sharp bursts registered on H28, slightly less heavily on H24 and still less on H29. But on H28 a series that looks like blasts registered just before this burst and show very slightly on H29 and only a little more on H24. See Note M.
- O. A series resembling blasts on H28 which are fairly well marked on H24 and hardly to be found on H29. Nearly all record 407 (H29, H31) (Jan. 21-22) shows the snaps having a tendency to occur in groups.
- P. On H29 only the major snaps of the short salvo are registered.
- Q. A series of such small salvos occurred on H31 and not on H27 or H25. One began at 4-56 a.m. Jan. 24 and lasted about a minute and another began at 4-59 and lasted about half a minute.
- R. A long drawn out salvo on H28 with a recrudescence at 4-15 a.m. Jan. 26. Only the larger snaps registered on H29 and H24.

Remarks (Continued)

- S. A long drawn out salvo on H28 with a recrudescence at 4-29 and another at 4-31. Registered only faintly on H29 and H24 except for the larger snaps. But on H29 there are a series of groups of snaps at intervals during the period 4-30 - 5-00 a.m. Jan. 26.
- T. A salvo which was best registered on H25 occurred just before the time switch changed. When it did change to H29, H28, H24, the record continued on H28 but did not register on H29 or H24.
- U. A long drawn out salvo on H28 which was only partly recorded on H29 or H24. It was preceded on H28 by a few abrupt short salvos which resemble ore skipping records but are not so to be explained.
- V. Well marked salvo on H28. Only the larger snaps registered on H29 and the salvo was merely a widening of the zero on H24. It was plainly seismic.
- W. The record 425(H29, H31) (Jan. 28-29) was lost in the crush burst of Jan. 29.

