

No. 17.

1931.

**Geodætisk Institut**  
 Proviantgaarden, Copenhagen, Denmark.

**Bulletin**  
 of the seismological station

**KØBENHAVN**

$\varphi = 55^{\circ}41' N.$   $\lambda = 12^{\circ}27' E.$   $h = 13$  m.

Lithologic foundation: chalk.

No. 17. Jan.—March 1931.

Instruments:

Galitzin pendulums with galvanometric registration.

Constants:

| Component | $l$        | $T_1$        | $A_1$     |                              | $\mu^2$ | $T$         | $k$ |
|-----------|------------|--------------|-----------|------------------------------|---------|-------------|-----|
| $N$       | cm<br>12.5 | sec<br>12.62 | cm<br>100 | $\frac{1}{3} - \frac{6}{3}$  | 0.14    | sec<br>12.5 | 103 |
| $E$       | 12.5       | 12.62        | 100       | $\frac{6}{3} - \frac{31}{3}$ | -0.02   | 12.4        | 103 |
| $Z$       | 14.4       | 11.56        | 100       |                              | -0.1    | 12.6        | 101 |
|           |            |              |           |                              |         | 10          | 95  |

Wiechert 1000 kg. horizontal seismograph.

Wiechert 1300 kg. vertical seismograph.

Constants:

| Component |                               | $T$        | $\nu$ | $\rho$    | $V$ |
|-----------|-------------------------------|------------|-------|-----------|-----|
| $N$       | $\frac{1}{3} - \frac{12}{3}$  | sec<br>9.6 | 4.4   | mm<br>0.8 | 223 |
| $E$       | $\frac{12}{3} - \frac{31}{3}$ | 9.6        | 4.5   | 0.5       | 220 |
| $Z$       |                               | 9.4        | 4.2   | 0.7       | 194 |
|           |                               | 5.3        | 4.3   | 0.2       | 165 |

Milne-Shaw seismograph,  $E$  component, with the approximate constants  $T = 12^s$   $\nu = 20$   $V = 300$ .

Wood-Anderson torsion seismometer,  $E$  component,  $T = c. 4^s$ .

København.

| No. | Date         | Hour | Forerunners   |                |               |                | L          | Un-<br>defined | △   | Remarks |
|-----|--------------|------|---------------|----------------|---------------|----------------|------------|----------------|---|---------|
|     |              |      | P             |                | S             |                |            |                |   |         |
|     |              |      | <i>m s</i>    | <i>m s</i>     | <i>h m s</i>  | <i>m s</i>     | <i>h m</i> | <i>h m</i>     | <i>°</i>  |         |
| 1   | 1931<br>Jan. | 2 0  |               |                | 14            |                | .5         |                |   |         |
| 2*  | 2*           | 10   | 2             |                |               |                |            |                |   |         |
| 3   | 4            | 0    | 5             | 8.7            |               |                | 11         |                | Pacific Ocean near Mexico.<br>Greece.                   |         |
| 4   | 7            | 2    |               |                |               |                | .5         |                |   |         |
| 5   | 8            | 11   |               |                | 10.4          |                |            |                | Artificial explosion, Limhamn,<br>Sweden.               |         |
| 6   | 9            | 2    |               |                |               |                | .4         |                |   |         |
| 7   | 9            | 7    |               |                |               |                | .3         |                |   |         |
| 8   | 9            | 12   |               |                |               |                | .1         |                |   |         |
| 9   | 11           | 19   |               |                |               |                | 29         |                |   |         |
| 10* | 12*          | 15   | 11 0          | 14 59          |               |                | 18         |                | 23  |         |
| 11  | 12           | 16   | 0.3           | 4.3            |               |                | 8          |                |   |         |
| 12  | 12           | 20   | 44 59         | 53 53          |               |                |            |                | 66  |         |
| 13* | 15*          | 2    | <i>i</i> 3 29 |                | 14 4          |                | 27         |                |   |         |
| 14  | 15           | 21   | 13.8          | 23.8           |               |                | .7         |                |   |         |
| 15  | 15           | 23   |               |                | .2            |                | .7         |                |   |         |
| 16  | 16           | 19   | 32 40         |                | 43 23*        |                | 1.0        |                |   |         |
| 17  | 17           | 3    | 3 1           | 13 23          |               |                | .4         |                | 82  |         |
| 18  | 17           | 6    |               |                |               |                | 21         |                |   |         |
| 19  | 19           | 12   |               |                |               |                |            | 52             |   |         |
| 20  | 19           | 17   |               |                |               |                | .3         |                |   |         |
| 21* | 20*          | 9    | 35 10*        |                |               |                |            |                |   |         |
| 22  | 20           | 15   |               |                | 49 15         |                |            |                |   |         |
| 23  | 21           | 0    |               |                |               |                |            | 39             |   |         |
| 24  | 23           | 6    |               |                |               |                | .6         |                |   |         |
| 25  | 24           | 14   |               |                | 5.2           |                | .4         |                |   |         |
| 26  | 24           | 17   |               |                |               |                |            | 50             |   |         |
| 27  | 25           | 13   |               |                |               |                | .3         |                |   |         |
| 28  | 25           | 18   |               |                |               |                |            | .7             |   |         |
| 29  | 26           | 22   |               |                |               |                | .8         |                | Faint.  |         |
| 30* | 27*          | 20   | 20 4          | <i>i</i> 28 52 | <i>i</i> 30 8 | 33 12*         |            |                | 65  |         |
| 31  | 28           | 5    | 59.0          | 62.0           |               |                | 63         |                | Burma.<br>Albania. <i>P</i> small.<br>Caroline Islands. |         |
| 32* | 28*          | 21   | 38.3          |                | 42 26         | <i>i</i> 48 56 |            |                |   |         |
| 33  | 29           | 1    |               |                |               |                | .5         |                |   |         |
| 34  | 29           | 17   |               |                | 34.2          |                | 53         |                |   |         |
| 35  | 30           | 4    |               |                |               |                |            | .1             | Faint.  |         |
| 36  | Febr.        | 1 1  |               |                |               |                | 50         |                |   |         |
| 37* | 2*           | 23   |               |                | 6 46          | 7 35           |            |                |   |         |
| 38  | 6            | 23   |               |                |               |                |            | 39             | New Zealand.  |         |
| 39  | 8            | 3    |               |                |               |                | .1         |                |   |         |
| 40  | 8            | 12   |               |                |               |                | 41         |                |   |         |
| 41  | 10           | 1    |               |                |               |                | 59         |                |   |         |
| 42* | 10*          | 6    | 47 56         |                | 58 49         |                |            |                |   |         |
| 43  | 11           | 18   |               |                |               |                | .5         |                | Sumatra.  |         |
| 44  | 12           | 6    |               |                | 9             |                | .6         |                | Forerunners masked by microseisms.                      |         |
| 45  | 13           | 1    |               |                |               |                |            | .4             | " " " "   |         |
| 46* | 13*          | 1    |               |                | 47.3          | 48.1           |            |                | New Zealand.  |         |
| 47  | 13           | 23   |               |                |               |                | .0         |                |   |         |
| 48  | 14           | 14   |               |                | 23.0          |                | .7         |                |   |         |

København.

| No. | Date          | Hour | Forerunners |         |       |         | L   | Un-<br>defined | △  | Remarks |
|-----|---------------|------|-------------|---------|-------|---------|-----|----------------|----|---------|
|     |               |      | P           | S       |       |         |     |                |    |         |
|     |               |      | m s         | m s     | h m s | m s     | h m | h m            | °  |         |
|     | 1931<br>Febr. |      |             |         |       |         |     |                |    |         |
| 49  | 16            | 19   |             |         |       |         | .4  |                |    |         |
| 50  | 19            | 18   |             |         | 5.0   |         | .5  |                |    |         |
| 51  | 19            | 22   |             |         |       |         | .5  |                |    |         |
| 52* | 20*           | 5    | i 43 57     | i 52 34 | 45 16 | i 53 21 |     |                | 64 |         |
| 53  | 20            | 10   |             |         | 32    |         | .7  |                |    |         |
| 54  | 24            | 14   |             |         |       |         | .7  |                |    |         |
| 55  | 24            | 18   |             |         |       |         | .5  |                |    |         |
| 56  | 27            | 9    |             |         | 56.0  | 62 10   | 1.4 |                |    |         |
| 57  | 27            | 12   |             |         |       |         | .0  |                |    |         |
|     | March         |      |             |         |       |         |     |                |    |         |
| 58* | 2*            | 2    |             |         | 37 51 | 41 1    | 1.3 |                |    |         |
| 59  | 3             | 10   |             |         |       |         |     | 15             |    |         |
| 60  | 3             | 20   |             |         |       |         | .1  |                |    |         |
| 61  | 5             | 4    |             |         |       |         |     | .0             |    |         |
| 62  | 5             | 18   |             |         | 18.0  |         | 39  |                |    |         |
| 63* | 7*            | 0    | 20 30       | 23 30   |       |         |     |                | 16 |         |
| 64  | 7             | 1    |             |         |       |         | .4  |                |    |         |
| 65  | 7             | 11   |             |         |       |         | .0  |                |    |         |
| 66* | 8*            | 1    | 54 0        | 57 0    |       |         | 58  |                | 16 |         |
| 67  | 8             | 5    |             |         |       |         |     | 13             |    |         |
| 68  | 8             | 13   |             |         |       |         | .2  |                |    |         |
| 69* | 9*            | 4    | 0 35        | 10 18   | 3 28  | 15.6    | 21  |                | 75 |         |
| 70  | 11            | 5    |             |         |       |         | .7  |                |    |         |
| 71  | 11            | 6    |             |         |       |         |     | .5             |    |         |
| 72* | 11*           | 12   | 39.9        |         | 43 23 | 50.6    | 1.2 |                |    |         |
| 73  | 12            | 11   |             |         | 4     |         | .4  |                |    |         |
| 74  | 12            | 19   |             |         |       |         |     | 3              |    |         |
| 75  | 12            | 19   |             |         | 39    |         | .9  |                |    |         |
| 76  | 12            | 21   |             |         |       |         | 46  |                |    |         |
| 77  | 14            | 11   |             |         |       |         | .2  |                |    |         |
| 78  | 14            | 12   |             |         |       |         | .9  |                |    |         |
| 79  | 15            | 15   |             |         |       |         |     | .9             |    |         |
| 80  | 15            | 17   |             |         |       |         | .2  |                |    |         |
| 81* | 18*           | 8    |             |         | 22.0  | 31 40   |     |                |    |         |
| 82* | 18*           | 20   | 27 13       | 38 32   | 31.2  |         | 57  |                |    |         |
| 83* | 19*           | 6    | 37 36       | i 47 55 | 41.0  | 48.5    | 1.1 |                |    |         |
| 84  | 19            | 19   |             |         |       |         |     | 9              |    |         |
| 85  | 21            | 23   |             |         |       |         |     | 11             |    |         |
| 86  | 22            | 4    |             |         |       |         |     | 0              |    |         |
| 87  | 22            | 15   |             |         |       |         | 51  |                |    |         |
| 88  | 24            | 13   |             |         |       |         | .4  |                |    |         |
| 89* | 28*           | 12   |             |         | 58 0  | 63 5    | .5  |                |    |         |
| 90  | 29            | 17   |             |         | 36 33 | 46 52   |     |                |    |         |
| 91* | 29*           | 18   | 3 33        | 12 33   |       |         |     |                | 67 |         |
| 92  | 30            | 8    |             |         |       |         | 9   |                |    |         |
| 93  | 30            | 11   |             |         |       |         | .6  |                |    |         |
| 94  | 30            | 14   |             |         | 1.0   |         | .4  |                |    |         |
| 95  | 30            | 16   |             |         |       |         | .9  |                |    |         |
| 96  | 31            | 16   |             |         | 25.2  |         | .6  |                |    |         |

## København.

## NOTES

- No. 2. Jan. 2. 10<sup>h</sup>. Pacific Ocean near Mexico. Phases not clearly marked; irregular microseismic movement.  $P$  about 2<sup>m</sup>;  $PP$  c. 6<sup>m</sup>.3;  $\overline{S_c P_c S}$ , small, 12<sup>m</sup>.6;  $S_n$ , larger, 13<sup>m</sup>.1. The beginning of  $L$  uncertain.
- No. 10. Jan. 12. 15<sup>h</sup>. Asia Minor. No  $GZ$  record.  $P$  small;  $S$  clearly marked by a large oscillation.
- No. 13. Jan. 15. 2<sup>h</sup>. Mexico. Very strong record.  $iP$ , dilatation, followed by large oscillations.  $PP$  smaller, not very clearly marked, about 7<sup>m</sup>.0. ( $\overline{S_c P_c S}$ ), 14<sup>m</sup>.4, clearly marked on  $N$ , on  $E$  less certain, perhaps earlier; followed by very large oscillations.  $PS$  15<sup>m</sup>.3.  $SS$  19<sup>m</sup>.3 and  $SSS$  24<sup>m</sup>.2 very large, of long period.  $L$  27<sup>m</sup>; on  $N$  28<sup>m</sup>—29<sup>m</sup> a few very large oscillations of long period.  $M$  large, regular.
- No. 21. Jan. 20. 9<sup>h</sup>. Alai Mountains;  $\Delta = c. 40^\circ$ . Much disturbed by work at the station. Clearly marked phases in forerunners; small main phase; presumably deep focus shock.  $e_{E,Z}$  36<sup>m</sup>19<sup>s</sup>.  $i_Z$  37<sup>m</sup>59<sup>s</sup>,  $i_E$  38<sup>m</sup>3<sup>s</sup>, large movement.  $e_E$  41<sup>m</sup>29<sup>s</sup>;  $e_E$  42<sup>m</sup>5;  $e_E$  44<sup>m</sup>55<sup>s</sup>.
- No. 30. Jan. 27. 20<sup>h</sup>. Burma. Strong record. The beginning of  $P$  small, the reading not quite certain (no  $WZ$  record);  $iP$  20<sup>m</sup>8<sup>s</sup>.  $S$  large, followed by large oscillations;  $i$  ( $\overline{S_c P_c S}$ ), 30<sup>m</sup>8<sup>s</sup>, very large.  $SS$ , 30<sup>m</sup>12<sup>s</sup>, followed by large oscillations; the beginning of  $L$  not certain.  $M$  large; very large  $M$  groups about 47<sup>m</sup>.0 on  $N$  and about 50<sup>m</sup>.6 on  $E$  and  $Z$ .
- No. 32. Jan. 28. 21<sup>h</sup>. Caroline Islands;  $\Delta = c. 105^\circ$ .  $P$  quite small;  $P'$ , 41<sup>m</sup>.4, distinct on  $Z$ ;  $PP$ , 42<sup>m</sup>26<sup>s</sup>, large;  $PPP$  44<sup>m</sup>.5.  $i \overline{S_c P_c S}$  48<sup>m</sup>56<sup>s</sup>,  $iPS$  51<sup>m</sup>38<sup>s</sup>, well marked phases;  $\overline{S_c P_c S}$  followed by some oscillations, but no other distinct phases before  $PS$ .  $SS$ , 57<sup>m</sup>.2, large. The beginning of  $L$  uncertain.
- No. 37. Febr. 2. 23<sup>h</sup>. New Zealand;  $\Delta = c. 160^\circ$ . Small beginning on  $Z$  c. 6<sup>m</sup>.6;  $P'_1$  6<sup>m</sup>46<sup>s</sup> and  $P'_2$  7<sup>m</sup>35<sup>s</sup>, large on  $Z$ .  $PP$  11<sup>m</sup>15<sup>s</sup>;  $PPP$  14<sup>m</sup>23<sup>s</sup>. In later forerunners strong irregular movement, phases not very clearly marked; clearest marked:  $PPS$  25<sup>m</sup>5<sup>s</sup>;  $e$  26<sup>m</sup>21<sup>s</sup>;  $SS$  32<sup>m</sup>.0. 39<sup>m</sup> a very large oscillation. The beginning of  $L$  uncertain; in first part large, irregular oscillations of long period; later regular  $M$  waves.
- No. 42. Febr. 10. 6<sup>h</sup>. Sumatra;  $\Delta = c. 95^\circ$ .  $P$  clearly marked on  $Z$ ; reflections small,  $PP$  c. 51<sup>m</sup>.8.  $\overline{S_c P_c S}$  58<sup>m</sup>49<sup>s</sup>;  $e_N$  59<sup>m</sup>38<sup>s</sup>;  $i_N$  59<sup>m</sup>23<sup>s</sup>, large.  $SS$  65<sup>m</sup>.6.  $L'$  c. 8<sup>h</sup>.7.
- No. 46. Febr. 13. 1<sup>h</sup>. New Zealand. Much disturbed by microseisms.  $P'_1$  47<sup>m</sup>.3,  $P'_2$  48<sup>m</sup>.1,  $PP$  51<sup>m</sup>.8, best marked on  $Z$ .  $e_N$  58<sup>m</sup>.5;  $e_{N,E}$  62<sup>m</sup>.9;  $SS$  72<sup>m</sup>.7.
- No. 52. Febr. 20. 5<sup>h</sup>. Siberia. Deep focus.  $P_Z$  very large; 45<sup>m</sup>16<sup>s</sup> large and clearly marked;  $e$  46<sup>m</sup>.4.  $S$  and the following phase very large and sharp;  $e$  54<sup>m</sup>.9. Small main phase.
- No. 58. March 2. 2<sup>h</sup>.  $\Delta = c. 130^\circ$ .  $P'_Z$  37<sup>m</sup>51<sup>s</sup>;  $PP$  41<sup>m</sup>.0;  $\overline{P_c P_c S}$  41<sup>m</sup>39<sup>s</sup>;  $PPP$  44<sup>m</sup>.2.  $e$  51<sup>m</sup>2;  $e$  53<sup>m</sup>32<sup>s</sup>.  $SS$  60<sup>m</sup>.3.
- No. 63. March 7. 0<sup>h</sup>. Yugoslavia. The beginning of  $S$  not very sharp;  $e_E$  23<sup>m</sup>39<sup>s</sup>, followed by larger movement.
- No. 66. March 8. 1<sup>h</sup>. Yugoslavia. Strong record. The beginning of  $P$  small, read at end of minute-break, not quite certain; followed by large oscillations. The beginning of  $S$  small;  $e_N$  57<sup>m</sup>10<sup>s</sup>,  $i_E$  57<sup>m</sup>14<sup>s</sup> followed by very large oscillations.  $M$  very large.
- No. 69. March 9. 4<sup>h</sup>. Japan. Strong record. Phases clearly marked.  $M$  very large.
- No. 72. March 11. 12<sup>h</sup>. Marianne Islands region.  $P$  small;  $PP$ , 43<sup>m</sup>23<sup>s</sup>, larger. 50<sup>m</sup>.6 a clearly marked phase, but the beginning not sharp; in following movement no clearly marked phases. Several  $M$  groups.
- No. 81. March 18. 8<sup>h</sup>. Chile;  $\Delta = c. 115^\circ$ . Disturbed by change of sheets.  $PP$  22<sup>m</sup>.0; on  $Z$  faint preceding movement. Later phases most clearly marked on  $E$ . 29<sup>m</sup>6<sup>s</sup>;  $PS_E$  31<sup>m</sup>40<sup>s</sup>;  $PS_Z$  31<sup>m</sup>55<sup>s</sup>;  $PPS$  32<sup>m</sup>.7.  $e_E$  34<sup>m</sup>46<sup>s</sup>.  $SS$  38<sup>m</sup>.0;  $SSS$  42<sup>m</sup>.5. The beginning of  $L$  uncertain; large, regular  $M$ .
- No. 82. March 18. 20<sup>h</sup>. 5° N 127° 30' E according to Manila;  $\Delta = c. 100^\circ$ . Strong microseisms.  $P$  and  $PP$ , 31<sup>m</sup>.2, small.  $\overline{S_c P_c S}$ , 37<sup>m</sup>.7, not clearly marked;  $S_n$  and  $PS$ , 39<sup>m</sup>20<sup>s</sup>, best marked on  $E$ .  $SS$  46<sup>m</sup>,  $SSS$  50<sup>m</sup>.
- No. 83. March 19. 6<sup>h</sup>. 18° 20' N 120° 10' E according to Manila;  $\Delta = c. 85^\circ$ .  $P$  clearly marked on  $Z$ ;  $e_{E,Z}$  37<sup>m</sup>50<sup>s</sup>, larger.  $S$  large and well defined;  $PS$ , 48<sup>m</sup>.5, smaller. No marked  $SR$ . Long period waves in first part of  $L$ ;  $M$  of short duration.
- No. 89. March 28. 12<sup>h</sup>. South Moluccas according to Batavia;  $\Delta = c. 110^\circ$ .  $P$ , 52<sup>m</sup>40<sup>s</sup>, small, the reading not quite certain; no  $GZ$  record. Some increase of movement ( $P'$ ) previous to  $PP$ , 58<sup>m</sup>0<sup>s</sup>.  $\overline{S_c P_c S}$  63<sup>m</sup>.5;  $\overline{S_c P_c P_c S}$  64<sup>m</sup>41<sup>s</sup>;  $S_n$  65<sup>m</sup>.4;  $PS$ , 67<sup>m</sup>.3, followed by increasing oscillations ( $PPS$ ).  $e$  69<sup>m</sup>.3;  $e_E$  70<sup>m</sup>.5;  $SS$  73<sup>m</sup>.3, followed by strong, irregular movement.  $L$  irregular, the beginning not certain.
- No. 91. March 29. 18<sup>h</sup>.  $P$  and  $S$  well defined phases.  $L$  irregular; no marked  $M$  phase.

No. 18.

1931.

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 Proviantgaarden, Copenhagen, Denmark.

**Bulletin**  
 of the seismological station

**KØBENHAVN**

$\varphi = 55^{\circ}41' N.$   $\lambda = 12^{\circ}27' E.$   $h = 13$  m.

Lithologic foundation: chalk.

No. 18. April—June 1931.

Instruments:

Galitzin pendulums with galvanometric registration

Constants:

| Component | $l$  | $T_1$ | $A_1$ | $\mu^2$ | $T$  | $k$ |
|-----------|------|-------|-------|---------|------|-----|
|           | cm   | sec   | cm    |         | sec  |     |
| <i>N</i>  | 12.5 | 12.62 | 100   | 0.00    | 12.4 | 104 |
| <i>E</i>  | 12.5 | 12.62 | 100   | 0.1     | 12.2 | 101 |
| <i>Z</i>  | 14.4 | 11.56 | 100   | -0.1    | 10   | 95  |

Wiechert 1000 kg. horizontal seismograph.

Wiechert 1300 kg. vertical seismograph.

Constants:

| Component | $T$ | $\nu$ | $\rho$ | $V$ |
|-----------|-----|-------|--------|-----|
|           | sec |       | mm     |     |
| <i>N</i>  | 9.6 | 4.5   | 0.6    | 220 |
| <i>E</i>  | 9.4 | 4.2   | 0.7    | 194 |
| <i>Z</i>  | 5.3 | 4.3   | 0.2    | 165 |

Milne-Shaw seismographs, *N* and *E* components, with the approximate constants  $T = 12^s$   $\nu = 20$   $V = 300$ .

Wood-Anderson torsion seismometer, *E* component,  $T = c. 4^s$ , recording intermittingly.

København.

| No. | Date         | Hour | Forerunners |       |         |       | L   | Un-<br>defined | △  | Remarks                   |
|-----|--------------|------|-------------|-------|---------|-------|-----|----------------|----|---------------------------|
|     |              |      | P           | S     |         |       |     |                |    |                           |
|     |              |      | m s         | m s   | h m s   | m s   | h m | h m            | °  |                           |
| 1   | 1931 April 1 | 14   |             |       |         |       | .1  |                |    |                           |
| 2   | 2            | 1    |             |       |         |       | .1  |                |    |                           |
| 3   | 3            | 2    |             |       | 20 33   | 21 25 | .8  |                |    |                           |
| 4   | 3            | 6    |             |       |         |       | .3  |                |    |                           |
| 5   | 3            | 21   |             |       | 56 40   | 62 48 | 1.2 |                |    |                           |
| 6*  | 3*           | 23   |             |       | i 37 42 | 40.3  |     |                |    |                           |
| 7   | 5            | 22   |             |       |         |       | .5  |                |    |                           |
| 8*  | 6*           | 7    |             |       | 10 10   | 20.1  | .7  |                |    |                           |
| 9   | 6            | 12   |             |       |         |       | .9  |                |    |                           |
| 10  | 7            | 0    |             |       |         |       |     | .9             |    |                           |
| 11  | 7            | 8    |             |       |         |       | .8  |                |    | Disturbed.                |
| 12  | 8            | 19   |             |       | 31.7    |       | .9  |                |    |                           |
| 13  | 9            | 23   | i 12 48     | 22 14 | 23.1    |       | .7  |                | 72 |                           |
| 14  | 11           | 1    |             |       |         |       |     | .5             |    | No time-marks.            |
| 15  | 11           | 15   |             |       | 33      |       | 1.1 |                |    |                           |
| 16  | 12           | 2    |             |       | 20      |       | 1.1 |                |    |                           |
| 17  | 13           | 12   |             |       |         |       | .8  |                |    | Faint.                    |
| 18  | 14           | 22   |             |       |         |       | .3  |                |    | Faint.                    |
| 19* | 15*          | 17   | 4 29        | 9.0   |         |       |     | 11             | 27 | Atlantic Ocean.           |
| 20  | 16           | 12   |             |       |         |       | .9  |                |    |                           |
| 21  | 19           | 2    |             |       | 30      |       | .7  |                |    | Superposed on next shock. |
| 22  | 19           | 3    |             |       |         |       | .3  |                |    |                           |
| 23* | 20*          | 20   | 38.8        | 42 50 |         |       |     | 46             |    | Asia Minor.               |
| 24  | 21           | 0    |             |       | 22.0    |       |     |                |    | Distant.                  |
| 25  | 21           | 6    |             |       |         |       | .0  |                |    |                           |
| 26  | 21           | 14   |             |       |         |       |     | 25             |    | Not very distant.         |
| 27  | 22           | 0    |             |       | .0      |       |     |                |    | Faint; distant.           |
| 28* | 22*          | 0    |             |       | 22.8    | 25.8  | 1.2 |                |    |                           |
| 29  | 24           | 0    |             |       |         |       | .7  |                |    |                           |
| 30  | 24           | 3    |             |       |         |       | .2  |                |    |                           |
| 31  | 24           | 15   |             |       | 30.3    |       |     |                |    | Following movement small. |
| 32* | 24*          | 17   |             |       | 41 12   | 42.7  |     | 74             |    |                           |
| 33  | 25           | 16   |             |       |         |       |     | 57             |    |                           |
| 34  | 25           | 20   |             |       |         |       | .1  |                |    |                           |
| 35  | 26           | 4    | 33 9        | 42.5  |         |       | .9  |                | 71 | Irregular.                |
| 36  | 26           | 6    |             |       |         |       | .6  |                |    | Armenia.                  |
| 37* | 27*          | 16   | i 56 31     | 61 14 |         |       |     |                | 28 |                           |
| 38  | 27           | 21   |             |       |         |       |     | 30             |    |                           |
| 39  | May 1        | 22   | 49.0        | 59.0  |         |       |     | 75             | 78 | Venezuela.                |
| 40  | 3            | 6    |             |       |         |       |     | 50             |    |                           |
| 41* | 3*           | 20   |             |       |         |       |     | .8             |    |                           |
| 42  | 4            | 3    |             |       |         |       | .5  |                |    |                           |
| 43  | 4            | 18   |             |       |         |       | .3  |                |    | Faint.                    |
| 44  | 5            | 6    |             |       |         |       |     | 56             |    | L small.                  |
| 45  | 5            | 14   |             |       | 25.0    |       |     |                |    |                           |
| 46  | 6            | 15   |             |       | .5      |       |     | 1.3            |    |                           |
| 47  | 6            | 17   |             |       | 39.8    | 44    |     |                |    |                           |
| 48  | 6            | 20   |             |       | 32 16   |       |     |                |    |                           |

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| No. | Date            | Hour | Forerunners    |                |               |            | L          | Un-<br>defined | △  | Remarks                             |
|-----|-----------------|------|----------------|----------------|---------------|------------|------------|----------------|----|-------------------------------------|
|     |                 |      | P              | S              |               |            |            |                |    |                                     |
|     | 1931<br>May     |      | <i>m s</i>     | <i>m s</i>     | <i>h m s</i>  | <i>m s</i> | <i>h m</i> | <i>h m</i>     | °  |                                     |
| 49  | 7               | 0    |                |                | 59.9          |            |            |                |    |                                     |
| 50  | 7               | 6    |                |                |               |            | .5         |                |    | Seismic?                            |
| 51  | 9               | 10   |                |                | 58.0          |            | 1.3        |                |    |                                     |
| 52  | 10              | 10   |                |                |               |            |            | 57             |    |                                     |
| 53  | 10              | 19   |                |                | 47.6          |            | 1.5        |                |    | Faint.                              |
| 54  | 11              | 19   |                |                |               |            | .2         |                |    |                                     |
| 55* | 12 <sup>o</sup> | 1    | <i>i</i> 48 9  | <i>i</i> 57 8  |               |            |            |                | 67 |                                     |
| 56  | 12              | 10   |                |                |               |            |            | 36             |    | L irregular.                        |
| 57  | 13              | 9    |                |                |               |            | .3         |                |    |                                     |
| 58  | 13              | 23   |                |                |               |            | .8         |                |    |                                     |
| 59  | 15              | 0    |                |                |               |            | .0         |                |    |                                     |
| 60* | 16*             | 21   | 0.2            | 11 3*          | 10 47         | 12.0       | .5         |                |    | Mexico.                             |
| 61  | 17              | 10   |                |                |               |            |            | 10             |    | Preceding movement disturbed.       |
| 62  | 17              | 13   |                |                |               |            | .5         |                |    |                                     |
| 63  | 17              | 15   |                |                | 34            |            | .7         |                |    |                                     |
| 64  | 18              | 11   |                |                |               |            | .6         |                |    | Small.                              |
| 65  | 19              | 14   |                |                |               |            | .1         |                |    |                                     |
| 66* | 20*             | 2    | <i>i</i> 28 28 | <i>i</i> 33 1  |               |            |            |                | 27 | Azores.                             |
| 67  | 20              | 22   |                |                | 13.0          | 19.1       | .8         |                |    |                                     |
| 68  | 22              | 8    |                |                |               |            |            | 9              |    |                                     |
| 69  | 24              | 0    |                |                | .6            |            | 1.0        |                |    |                                     |
| 70  | 24              | 21   |                |                | 40.8          |            |            |                |    |                                     |
| 71  | 26              | 10   |                |                |               |            | .0         |                |    | Faint.                              |
| 72  | 26              | 15   |                |                |               |            | .1         |                |    |                                     |
| 73  | 27              | 1    |                |                |               |            | .3         |                |    |                                     |
| 74  | 27              | 6    |                |                | 19 43         |            | .6         |                |    |                                     |
| 75  | 27              | 7    |                |                |               |            | .6         |                |    |                                     |
| 76  | 27              | 11   |                |                |               |            |            | .2             |    |                                     |
| 77  | 28              | 3    |                |                |               |            |            | 39             |    |                                     |
| 78  | 28              | 5    |                |                |               |            | .5         |                |    |                                     |
| 79  | 28              | 18   | 45 16          | 54 22          |               |            | 1.2        |                | 68 |                                     |
| 80  | 29              | 6    |                |                |               |            | .3         |                |    |                                     |
| 81  | 29              | 9    |                |                |               |            | .3         |                |    |                                     |
| 82  | 30              | 11   |                |                | 45.7          | 55.1       | 1.2        |                |    | Beginning lost by change of sheets. |
| 83  | 30              | 19   |                |                |               |            | .7         |                |    |                                     |
|     | June            |      |                |                |               |            |            |                |    |                                     |
| 84  | 1               | 0    |                |                |               |            |            | 46             |    |                                     |
| 85  | 1               | 12   |                |                | 14.8          |            | .9         |                |    |                                     |
| 86  | 1               | 14   |                |                |               |            |            | .7             |    | Superposed on preceding shock.      |
| 87* | 2*              | 2    | 49 22          | 58 49          | 50 21         | 60 34      |            |                | 72 | Japan.                              |
| 88  | 2               | 5    |                |                |               |            | .1         |                |    |                                     |
| 89  | 2               | 18   |                |                |               |            |            | 1              |    |                                     |
| 90  | 4               | 10   |                |                | .3            |            | .8         |                |    |                                     |
| 91  | 5               | 20   |                |                |               |            |            | 50             |    |                                     |
| 92* | 6*              | 12   |                |                | 13 8          |            |            | 3              |    |                                     |
| 93  | 6               | 17   |                |                |               |            |            |                |    |                                     |
| 94* | 7*              | 0    | <i>i</i> 26 51 | <i>i</i> 27 59 | <i>i</i> 27 1 |            |            |                |    | North Sea.                          |
| 95  | 9               | 0    |                |                |               |            |            | .9             |    |                                     |
| 96  | 9               | 5    | 19 43          | 29 37          | 29 58         |            | .8         |                | 77 | Japan.                              |

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| No.  | Date         | Hour | Forerunners |       |       |       | L   | Un-<br>defined | △  | Remarks                   |
|------|--------------|------|-------------|-------|-------|-------|-----|----------------|----|---------------------------|
|      |              |      | P           | S     |       |       |     |                |    |                           |
|      | 1931<br>June |      | m s         | m s   | h m s | m s   | h m | h m            | °  |                           |
| 97   | 9            | 12   | 25 23       | 34.5  |       |       | .9  |                | 68 |                           |
| 98   | 9            | 14   |             |       | 11.8  | 15.4  | 1.0 |                |    | Superposed on next shock. |
| 99*  | 9*           | 16   |             |       | 18 25 |       |     |                |    |                           |
| 100  | 10           | 12   |             |       |       |       |     | 48             |    |                           |
| 101  | 10           | 17   |             |       |       |       |     | 8              |    |                           |
| 102  | 11           | 7    |             |       |       |       | .0  |                |    |                           |
| 103  | 12           | 2    |             |       |       |       |     | .4             |    | Faint.                    |
| 104  | 13           | 15   |             |       |       |       |     | .0             |    |                           |
| 105  | 13           | 15   |             |       | 53 48 |       | 2.0 |                |    |                           |
| 106  | 15           | 11   |             |       | 44    |       | 1.1 |                |    |                           |
| 107  | 17           | 12   | 21 37       | 31 25 | 24 32 | 36 35 | .8  |                | 75 |                           |
| 108  | 17           | 17   |             |       | 22.0  | 31.9  | 1.0 |                |    |                           |
| 109  | 18           | 13   | 8 7*        | 15 52 | 19.5  |       | 28  |                | 56 |                           |
| 110  | 19           | 22   |             |       |       |       |     | .1             |    |                           |
| 111  | 20           | 1    |             |       | 36.2  |       | .9  |                |    |                           |
| 112  | 20           | 15   |             |       | 17.2  |       | .4  |                |    |                           |
| 113  | 21           | 13   |             |       |       |       | .2  |                |    | Faint preceding movement. |
| 114  | 22           | 10   |             |       |       |       | .4  |                |    |                           |
| 115  | 22           | 16   |             |       |       |       | .9  |                |    |                           |
| 116  | 23           | 6    | 26 58*      | 36 51 | 41.9  |       | .9  |                | 76 |                           |
| 117  | 23           | 12   |             |       |       |       | .7  |                |    |                           |
| 118  | 24           | 23   | 56.5        | 64.1  |       |       | 1.3 |                |    |                           |
| 119  | 25           | 1    |             |       |       |       | .3  |                |    |                           |
| 120  | 27           | 18   |             |       | .5    |       | 1.0 |                |    |                           |
| 121  | 28           | 6    |             |       |       |       | .3  |                |    |                           |
| 122  | 28           | 12   |             |       |       |       |     |                | 56 |                           |
| 123  | 28           | 16   |             |       | 47    |       | 1.1 |                |    |                           |
| 124  | 29           | 16   | 54 42       | 64 7  |       |       |     |                | 71 | L small. Japan.           |
| 125* | 29*          | 20   |             |       |       |       | 56  |                |    |                           |
| 126* | 29*          | 21   |             |       |       |       | .4  |                |    |                           |
| 127  | 30           | 10   | 29.1        | 32 11 |       |       |     |                | 16 | Italy.                    |

No. 6.  
 No. 8.  
 No. 19.  
 No. 23.  
 No. 28.  
 No. 32.  
 No. 37.  
 No. 41.  
 No. 55.  
 No. 60.  
 No. 66.  
 No. 87.  
 No. 92.  
 No. 94.  
 No. 99.  
 Nos. 125—



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NOTES

- No. 6. April 3. 23<sup>h</sup>. The first phase,  $P'$ , large on  $Z$ ; the rest of the record small. The beginning of  $L$  uncertain, 23<sup>h</sup>.9—24<sup>h</sup>.0.
- No. 8. April 6. 7<sup>h</sup>.  $PP$ , 10<sup>m</sup>10<sup>s</sup>, clearly marked on  $Z$  and  $E$ .  $e_z$  25<sup>m</sup>53<sup>s</sup>.
- No. 19. April 15. 17<sup>h</sup>.  $P$  clearly marked on  $Z$  and  $E$ , absent on  $N$ .  $S$  quite large, but the beginning not sharp.
- No. 23. April 20. 20<sup>h</sup>.  $P$  quite small;  $S$  clearly marked.  $L$  begins very clearly with waves of long period.
- No. 28. April 22. 0<sup>h</sup>. Preceded by faint movement due to other shock. Distinct forerunners, but later phases not clearly marked.  $L$  regular.
- No. 32. April 24. 17<sup>h</sup>.  $\Delta = c. 120^\circ$ .  $P'$ , 41<sup>m</sup>12<sup>s</sup>, small;  $PP$ , 42<sup>m</sup>.7, large. In later forerunners phases not very clearly marked.  $S_e P_e S$  48<sup>m</sup>.1;  $PS$  52<sup>m</sup>.4;  $SS$  58<sup>m</sup>.5. In first part of  $L$  periods of more than 1 min.
- No. 37. April 27. 16<sup>h</sup>. Armenia.  $P$ , dilatation, large on  $Z$  and  $E$ , followed by much oscillatory movement;  $e_N$  56<sup>m</sup>.9.  $S$  well-defined on  $E$ , followed by large oscillations; on  $N$  small, but large increase of movement 62<sup>m</sup>.1.  $L$  irregular.
- No. 41. May 3. 20<sup>h</sup>. The reading of this and the following shock uncertain, since  $L$  waves are not easily distinguished from a movement of long period which disturbs the record May 3.—4.
- No. 55. May 12. 1<sup>h</sup>.  $P$ , condensation, and  $S$  both very clearly marked.  $S$  followed by a group of oscillations, but no other distinct phases. The beginning of  $L$  uncertain.
- No. 60. May 16. 21<sup>h</sup>. Mexico.  $P$  small;  $PP$ , 3<sup>m</sup>46<sup>s</sup>, larger;  $PPP$  5<sup>m</sup>42<sup>s</sup>.  $S_e P_e S$ ,  $S_n$  and  $PS$  well-defined on  $E$ .  $SS$  c. 17<sup>m</sup>.  $L$  regular; in first part waves of long period.
- No. 66. May 20. 2<sup>h</sup>. Near Azores. Very strong record.  $iP$ , condensation;  $i$  28<sup>m</sup>57<sup>s</sup> followed by larger oscillations.  $S$  very large; large oscillations continue into  $L$ , beginning about 35<sup>m</sup>. Very large  $M$ , largest on  $N$ .
- No. 87. June 2. 2<sup>h</sup>. Japan. Kōti states: Deep focus.  $P$  and the following phase quite small, on  $Z$  only.  $S$  and the following phase clearly marked on  $N$  and  $E$ , the latter the larger.  $e$  63<sup>m</sup>.8.  $L$  irregular, not large, the beginning uncertain.
- No. 92. June 6. 12<sup>h</sup>. Clearly marked impulse on  $Z$ , quite small movement on  $N$  and  $E$ , lasts about 10 sec. only and not followed by other phases. Read at Stuttgart at about the same time.  $P'$  of a distant earthquake?
- No. 94. June 7. 0<sup>h</sup>. North Sea, near the English coast;  $\Delta = c. 650$  km. Felt in England; felt slightly in Denmark.  $iP$ , condensation, large on  $Z$ ;  $i_{E,Z}$  27<sup>m</sup>1<sup>s</sup>, larger.  $e_E$  27<sup>m</sup>13<sup>s</sup>, followed by larger movement of long period ( $PL?$ ) with movement of short period superposed.  $S$  very well defined on  $N$ ; followed by large movement of long period with short period waves superposed. Pronounced  $M$  group on  $N$ , begins 29<sup>m</sup>.0.
- No. 99. June 9. 16<sup>h</sup>. Probable epicentre 38° S 174° W according to Wellington. First phase clearly marked on  $Z$ , followed by some oscillations. Later forerunners distinct, but phases not clearly marked. The beginning of  $L$  not certain;  $M$  very regular, of long duration.
- Nos. 125—126. June 29. 20<sup>h</sup>; 21<sup>h</sup>. Forerunners begin about 20<sup>h</sup>51<sup>m</sup>. After 20<sup>h</sup>56<sup>m</sup> movement of the appearance of  $L$  waves of a not very distant shock. 21<sup>h</sup>.4 regular  $L$  waves of a distant shock.

