No. 17. 1931.

Geodætisk Institut
Proviantgaarden, Copenhagen, Denmark.

Bulletin

of the seismological station

KØBENHAVN

$\varphi = 55°41'$ N. $\lambda = 12°27'$ 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		μ^2	T	k
	cm	sec	cm			sec	
N	12.5	12.62	100	$^1/_1$—$^6/_3$	0.14	12.5	103
				$^6/_3$—$^{31}/_3$	— 0.02	12.4	103
E	12.5	12.62	100		0.1	12.6	101
Z	14.4	11.56	100		— 0.1	10	95

Wiechert 1000 kg. horizontal seismograph.

Wiechert 1300 kg. vertical seismograph.

Constants:

Component		T	ν	ϱ	V
		sec		mm	
N	$^1/_1$—$^{12}/_1$	9.6	4.4	0.8	223
	$^{12}/_1$—$^{31}/_3$	9.6	4.5	0.5	220
E		9.4	4.2	0.7	194
Z		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.

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

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No.	Date	Hour	Forerunners P	Forerunners S			L	Un-defined	△	Remarks
	1931 Febr.		m s	m s	h m s	m s	h m	h m	°	
49	16	19					.4			Faint forerunners masked by microseisms.
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	Siberia.
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	Yugoslavia.
64	7	1					.4			Superposed on preceding shock.
65	7	11					.0			Faint preceding movement.
66*	8*	1	54 0	57 0			58		16	Yugoslavia.
67	8	5						13		
68	8	13					.2			
69*	9*	4	0 35	10 18	3 28	15.6	21		75	Japan.
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			Faint.
78	14	12					.9			„
79	15	15						.9		„
80	15	17					.2			
81*	18*	8			22.0	31 40				Chile.
82*	18*	20	27 13	38 32	31.2		57			SE of Mindanao.
83*	19*	6	37 36	*i* 47 55	41.0	48.5	1.1			Near Luzon.
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				36^m33^s on *Z* only.
91*	29*	18	3 33	12 33					67	
92	30	8					9			
93	30	11					.6			Faint.
94	30	14			1.0		.4			
95	30	16					.9			
96	31	16			25.2		.6			

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NOTES

No. 2. Jan. 2. 10^h. Pacific Ocean near Mexico. Phases not clearly marked; irregular microseismic movement. *P* about 2^m; *PP* c. $6^m.3$; $\overline{S_cP_cS}$, small, $12^m.6$; S_n, larger, $13^m.1$. The beginning of *L* uncertain.

No. 10. Jan. 12. 15^h. Asia Minor. No *GZ* record. *P* small; *S* clearly marked by a large oscillation.

No. 13. Jan. 15. 2^h. Mexico. Very strong record. *iP*, dilatation, followed by large oscillations. *PP* smaller, not very clearly marked, about $7^m.0$. ($\overline{S_cP_cS}$), 14^m4^s, clearly marked on *N*, on *E* less certain, perhaps earlier; followed by very large oscillations. *PS* $15^m.3$. *SS* $19^m.3$ and *SSS* $24^m.2$ very large, of long period. *L* 27^m; on *N* 28^m—29^m a few very large oscillations of long period. *M* large, regular.

No. 21. Jan. 20. 9^h. Alai Mountains; △ = c. 40°. Much disturbed by work at the station. Clearly marked phases in forerunners; small main phase; presumably deep focus shock. $e_{E,Z}$ 36^m19^s. i_Z 37^m59^s, i_E 38^m3^s, large movement. e_E 41^m29^s; e_E $42^m.5$; e_E 44^m55^s.

No. 30. Jan. 27. 20^h. Burma. Strong record. The beginning of *P* small, the reading not quite certain (no *WZ* record); *iP* 20^m8^s. *S* large, followed by large oscillations; *i* ($\overline{S_cP_cS}$), 30^m8^s, very large. *SS*, 30^m12^s, followed by large oscillations; the beginning of *L* not certain. *M* large; very large *M* groups about $47^m.0$ on *N* and about $50^m.6$ on *E* and *Z*.

No. 32. Jan. 28. 21^h. Caroline Islands; △ = c. 105°. *P* quite small; *P'*, $41^m.4$, distinct on *Z*; *PP*, 42^m26^s, large; *PPP* $44^m.5$. *i* $\overline{S_cP_cS}$ 48^m56^s, *iPS* 51^m38^s, well marked phases; $\overline{S_cP_cS}$ followed by some oscillations, but no other distinct phases before *PS*. *SS*, $57^m.2$, large. The beginning of *L* uncertain.

No. 37. Febr. 2. 23^h. New Zealand; △ = c. 160°. Small beginning on *Z* c. $6^m.6$; P_1' 6^m46^s and P_2' 7^m35^s, large on *Z*. *PP* 11^m15^s; *PPP* 14^m23^s. In later forerunners strong irregular movement, phases not very clearly marked; clearest marked: *PPS* 25^m5^s; *e* 26^m21^s; *SS* $32^m.0$. 39^m 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^h. Sumatra; △ = c. 95°. *P* clearly marked on *Z*; reflections small, *PP* c. $51^m.8$. $\overline{S_cP_cS_E}$ 58^m49^s; e_N 59^m3^s*; i_N 59^m23^s, large. *SS* $65^m.6$. *L'* c. $8^h.7$.

No. 46. Febr. 13. 1^h. New Zealand. Much disturbed by microseisms. P_1' $47^m.3$, P_2' $48^m.1$, *PP* $51^m.8$, best marked on Z. e_N $58^m.5$; $e_{N,E}$ $62^m.9$; *SS* $72^m.7$.

No. 52. Febr. 20. 5^h. Siberia. Deep focus. P_Z very large; 45^m16^s large and clearly marked; *e* $46^m.4$. *S* and the following phase very large and sharp; *e* $54^m.9$. Small main phase.

No. 58. March 2. 2^h. △ = c. 130°. P_Z' 37^m51^s; *PP* $41^m.0$; $\overline{P_cP_cS}$ 41^m39^s; *PPP* $44^m.2$. *e* 51^m2; *e* 53^m32^s. *SS* $60^m.3$.

No. 63. March 7. 0^h. Yugoslavia. The beginning of *S* not very sharp; e_E 23^m39^s, followed by larger movement.

No. 66. March 8. 1^h. 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^m10^s, i_E 57^m14^s followed by very large oscillations. *M* very large.

No. 69. March 9. 4^h. Japan. Strong record. Phases clearly marked. *M* very large.

No. 72. March 11. 12^h. Marianne Islands region. *P* small; *PP*, 43^m23^s, larger. $50^m.6$ a clearly marked phase, but the beginning not sharp; in following movement no clearly marked phases. Several *M* groups.

No. 81. March 18 8^h. Chile; △ = c. 115°. Disturbed by change of sheets. *PP* $22^m.0$; on *Z* faint preceding movement. Later phases most clearly marked on *E*. 29^m6^s; PS_E 31^m40^s; PS_Z 31^m55^s; *PPS* $32^m.7$. e_E 34^m46^s. *SS* $38^m.0$; *SSS* $42^m.5$. The beginning of *L* uncertain; large, regular *M*.

No. 82. March 18. 20^h. 5° N 127° 30′ E according to Manila; △ = c. 100°. Strong microseisms. *P* and *PP*, $31^m.2$, small. $\overline{S_cP_cS}$, $37^m.7$, not clearly marked; S_n and *PS*, 39^m20^s, best marked on *E*. *SS* 46^m, *SSS* 50^m.

No. 83. March 19. 6^h. 18° 20′ N 120° 10′ E according to Manila; △ = c. 85°. *P* clearly marked on *Z*; $e_{E,Z}$ 37^m50^s, larger. *S* large and well defined; *PS*, $48^m.5$, smaller. No marked *SR*. Long period waves in first part of *L*; *M* of short duration.

No. 89. March 28. 12^h. South Moluccas according to Batavia; △ = c. 110°. *P*, 52^m40^s, small, the reading not quite certain; no *GZ* record. Some increase of movement (*P'*) previous to *PP*, 58^m0^s. $\overline{S_cP_cS}$ $63^m.5$; $\overline{S_cP_cP_cS}$ 64^m41^s; S_n $65^m.4$; *PS*, $67^m.3$, followed by increasing oscillations (*PPS*). *e* $69^m.3$; e_E $70^m.5$; *SS* $73^m.3$, followed by strong, irregular movement. *L* irregular, the beginning not certain.

No. 91. March 29. 18^h. *P* and *S* well defined phases. *L* irregular; no marked *M* phase.

BIANCO LUNO A/S. KBHVN

No. 18. 1931.

Geodætisk Institut

Proviantgaarden, Copenhagen, Denmark.

Bulletin

of the seismological station

KØBENHAVN

φ = 55°41′ N. λ = 12°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	μ^2	T	k
	cm	sec	cm		sec	
N	12.5	12.62	100	0.00	12.4	104
E	12.5	12.62	100	0.1	12.2	101
Z	14.4	11.56	100	−0.1	10	95

Wiechert 1000 kg. horizontal seismograph.

Wiechert 1300 kg. vertical seismograph.

Constants:

Component	T	ν	ϱ	V
	sec		mm	
N	9.6	4.5	0.6	220
E	9.4	4.2	0.7	194
Z	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.

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No.	Date	Hour	Forerunners P	Forerunners S			L	Un-defined	△	Remarks
	1931 April		m s	m s	h m s	m s	h m	h m	°	
1	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	
36	26	6					.6			Irregular.
37*	27*	16	*i* 56 31	61 14					28	Armenia.
38	27	21						30		
	May									
39	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		
45	5	14			25.0					*L* small.
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 P	Forerunners S			L	Un-defined	△	Remarks
	1931 May		m s	m s	h m s	m s	h m	h m	°	
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*	1	*i* 48 9	*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* 28 28	*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			Beginning lost by change of sheets.
82	30	11			45.7	55.1	1.2			
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					
93	6	17						3		
94*	7*	0	*i* 26 51	*i* 27 59	*i* 27 1					North Sea.
95	9	0						.9		
96	9	5	19 43	29 37	29 58		.8		77	Japan.

København.

No.	Date	Hour	Forerunners P	Forerunners S			L	Undefined	△	Remarks
	1931 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.

København.

NOTES

No. 6. April 3. 23^h. The first phase, P', large on Z; the rest of the record small. The beginning of L uncertain, $23^h.9$—$24^h.0$.

No. 8. April 6. 7^h. PP, 10^m10^s, clearly marked on Z and E. e_Z 25^m53^s.

No. 19. April 15. 17^h. P clearly marked on Z and E, absent on N. S quite large, but the beginning not sharp.

No. 23. April 20. 20^h. P quite small; S clearly marked. L begins very clearly with waves of long period.

No. 28. April 22. 0^h. Preceded by faint movement due to other shock. Distinct forerunners, but later phases not clearly marked. L regular.

No. 32. April 24. 17^h. △ = c. 120°. P', 41^m12^s, small; PP, $42^m.7$, large. In later forerunners phases not very clearly marked. $\overline{S_cP_cS}$ $48^m.1$; PS $52^m.4$; SS $58^m.5$. In first part of L periods of more than 1 min.

No. 37. April 27. 16^h. Armenia. P, dilatation, large on Z and E, followed by much oscillatory movement; e_N $56^m.9$. S well-defined on E, followed by large oscillations; on N small, but large increase of movement $62^m.1$. L irregular.

No. 41. May 3. 20^h. 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^h. 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^h. Mexico. P small; PP, 3^m46^s, larger; PPP 5^m42^s. $\overline{S_cP_cS}$, S_n and PS well-defined on E. SS c. 17^m. L regular; in first part waves of long period.

No. 66. May 20. 2^h. Near Azores. Very strong record. iP, condensation; i 28^m57^s followed by larger oscillations. S very large; large oscillations continue into L, beginning about 35^m. Very large M, largest on N.

No. 87. June 2. 2^h. Japan. Kôti 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 $63^m.8$. L irregular, not large, the beginning uncertain.

No. 92. June 6. 12^h. 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^h. North Sea, near the English coast; △ = c. 650 km. Felt in England; felt slightly in Denmark. iP, condensation, large on Z; $i_{E,Z}$ 27^m1^s, larger. e_E 27^m13^s, 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 $29^m.0$.

No. 99. June 9. 16^h. 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^h; 21^h. Forerunners begin about 20^h51^m. After 20^h56^m movement of the appearance of L waves of a not very distant shock. $21^h.4$ regular L waves of a distant shock.

No. 19. 1931.

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Proviantgaarden, Copenhagen, Denmark.

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of the seismological station

KØBENHAVN

$\varphi = 55°41'$ N. $\lambda = 12°27'$ E. $h = 13$ m.

Lithologic foundation: chalk.

No. 19. July—Sept. 1931.

Instruments:

Galitzin pendulums with galvanometric registration.

Constants:

Component	l	T_1	A_1	μ^2	T	k
	cm	sec	cm		sec	
N	12.5	12.62	100	0.02	12.4	103
E	12.5	12.62	100	0.14	12.1	101
Z	14.4	14.56	100	— 0.1	10	90

Wiechert 1000 kg. horizontal seismograph.

Wiechert 1300 kg. vertical seismograph.

Constants:

Component	T	v	ϱ	V
	sec		mm	
N	9.8	4.8	0.6	225
E	9.6	4.3	0.8	195
Z	5.6	4	0.2	165

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

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No.	Date	Hour	Forerunners P	Forerunners S			L	Un-defined	△	Remarks
	1931 July		m s	m s	h m s	m s	h m	h m	°	
1	2	4			2.0		.4			
2	4	21			12					
3	4	22					.4			
4	5	4			39		42			
5	5	7						.2		
6	5	7	21 43	25 55			28		24	
7*	5*	7					52			
8	5	18						8		
9	6	18					.3			
10	7	4	7 14		10 34	17.7	.6			
11	10	21					.6			
12*	12*	16	58 35		69 3	69 29	92			Pacific Ocean.
13	12	22			28.7		32			Asia Minor.
14	13	12					.5			
15	14	3					.5			
16	14	8					.4			
17	14	13					.9			
18	14	16			.0		.6			
19	15	16	37 5	45 18	40.7	49.0	.9		60	
20	15	18					.3			
21	16	20					.3			Small preceding movement.
22	17	9			29 58*	36 58*	55			Disturbed.
23	17	12			6.0		.4			
24	18	5			51.6	59.9	1.3			
25	18	11	*i* 34 42	*i* 43 33	44 23	51.7			66	
26	19	20			32.3		.8			
27	20	8			53.5		1.6			
28*	21*	3			55 34	58 40				
29	23	3			15.4		17			
30	23	14			40 58*	56.8	1.2			New Guinea.
31	25	6			51.8		57			
32	25	7			52		57			
33	25	12					.3			
34	25	12			59.8		1.2			
35	27	6					.6			
36	27	8					.0			
37	27	16			54.9		1.3			
38	28	4					.7			
39	28	17			49 41		1.0			Persia.
40	29	11			55		1.1			
41	29	17			29		.7			
42	29	18			6.9	13.4	.3			
43	31	0	31	35.2			40			
44	31	23					.1			
	Aug.									
45	1	1					.1			
46	1	19			35		1.5			
47	1	23					10			
48	2	18			25	31.8				

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No.	Date	Hour	Forerunners P	Forerunners S			L	Un-defined	△	Remarks
	1931 Aug.		m s	m s	h m s	m s	h m	h m	°	
49	2	20			28		1.0			
50	2	23	40 5		48 33					
51	4	6					.2			
52	4	15					.9			
53	5	8					.2			
54	6	16					.1			Small preceding movement.
55	6	18	25 3	32.2	27.0	35.8			50	*S* small.
56*	7*	2	26.6		31.2	37.0				Pacific Ocean.
57	7	11			1.7		.2			
58	8	1			21.5		.9			
59	8	4			29.0		.9			
60	8	9			8		.3			
61	8	21					.9			
62	9	10						4		
63	10	3			7.1					
64	10	10					1.1			Preceding movement disturbed.
65	10	15					.3			
66*	10*	21	27 7							
67	10	23						.7		Superposed on preceding.
68	11	1					58			" " "
69	11	2					48			" " "
70	11	3			.7		50			
71	11	4					49			
72	11	6					.9			
73	11	7			22.1		28			Faint preceding movement.
74	11	8					.7			Disturbed.
75	11	10					27			
76	11	13					.0			
77	11	14					.1			
78	11	18					.3			Faint preceding movement.
79	11	23					.5			
80	12	4					.2			
81	12	6					20			
82	12	6					.9			
83	12	7					.4			
84	12	8					.3			
85	12	15					27			
86	12	17					41			
87	12	20					14			
88	13	0					.0			
89	13	1					.3			
90	13	14					45			
91	13	22			29 1	32.9	1.4			Later phases not clearly marked.
92	14	1						.7		
93	14	2						.7		
94	14	13					.1			
95	14	16	23 25	33.0			.8			South of Aleutian Islands.
96*	15*	4	*i* 8 48	15.0	11 41	18.3				
97	15	14					.0			
98	15	15					45			

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No.	Date	Hour	Forerunners P	Forerunners S			L	Un-defined	△	Remarks
	1931 Aug.		m s	m s	h m s	m s	h m	h m	°	
99	16	2			11		.4			
100	16	11	52 26	62 25	67					Mexico.
101	17	9					.7			Faint preceding movement.
102	17	18	1 3	11.1			.5			*S* small, uncertain.
103	18	5	52.2	62.5			1.3			*P* and *S* quite small.
104	18	9	51 17	54.6				57		Macedonia. *P* and *S* small.
105*	18*	14	29 31	*i*36 20	31 22	39.5				Mongolia.
106	18	18					.1			
107	18	18					.3			
108	18	23					.4			
109	19	1					.9			
110	19	2					.2			
111	19	23					.6			
112	20	0			34		.8			
113	21	1						38		
114	21	2					.7			
115	22	17					.4			
116	22	18					.5			
117	23	1					.9			
118	23	16					.0			
119	23	18					.7			
120	24	3					24			Small preceding movement.
121*	24*	21	43 49	50 41	45 44	54.0	1.0			Baluchistan.
122	24	23			38.6		.9			
123	25	1					.0			
124	25	3	14.8	21 33	25.3		.6			
125	25	10					.6			
126	25	16			1		.2			
127	25	19			8		.3			
128	25	22					.1			Faint.
129	25	23					.2			
130	26	1					.0			
131	26	8					.4			
132	26	11			5.6		.2			
133	26	15					.8			
134	26	17						17		
135	26	19			44.9		.9			
136	26	22			16.3	19.9	.4			
137	27	6					.6			
138	27	7					.8			
139*	27*	15	35 46	42 31	37 29	45.7			46	Baluchistan.
140	28	0	50 53	57 51	52.7	61			48	„
141	28	3						51		
142	28	7						4		
143	28	15						29		
144	28	19	48 29	55 25			1.1		48	Sulaiman Range.
145	28	21			39.5		.9			
146	29	2					.3			
147	29	12			42.9		.8			
148	29	13			41.1		.9			

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No.	Date	Hour	Forerunners P	Forerunners S			L	Un-defined	△	Remarks
	1931 Aug.		m s	m s	h m s	m s	h m	h m	°	
149	29	20					.4			
150	30	6					.3			
151	30	8			1		.4			
152	30	22						.4		
153	31	7					.4			Faint preceding movement.
	Sept.									
154	2	3					.8			
155	2	6					.8			
156	3	17					.6			
157	5	1					32			
158	6	8	7 54	12 28					27	Atlantic Ocean S. of Greenland.
159	6	14					.9			
160	7	12					.6			
161	7	21					.7			
162	8	16					.7			
163	8	19	20 59	30 56	23.9		.8		77	Pacific Ocean E. of Japan.
164	9	14					.2			
165*	9*	20	51 32		55 23					
166*	9*	20	52.4		56.2					
167	10	21					.5			
168	10	22					.9			
169	11	14	38.4	41.9				44		
170	11	16	27 31	31 0				33	19	
171	11	22					.4			
172	11	23					.8			
173	12	1	55 48	64 28			1.3		64	Kamtchatka.
174	12	7			7.9			11		
175	12	8					.3			
176	12	13					.0			
177	12	15			54 18	64 49	1.4			
178	13	0					.6			
179	13	4					.0			
180	13	6					.5			
181	14	3		46 11	49 37					
182	15	17					.4			
183	16	12	55 5*				1.4			Japan.
184	18	19					.4			
185	19	8					.5			Small preceding movement, masked
186	19	9					.6			[by microseisms.
187	21	2	31 57	41 48			1.0		76	Japan.
188	21	10	39 30	49 29			1.1		78	Annam.
189	21	13	54							Small, masked by microseisms.
190	21	22					.6			
191	22	2					.2			
192	22	10					.5			
193	23	2					.6			
194	23	13					.6			
195	23	18						31		Faint.
196	25	5						.0		„

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No.	Date	Hour	Forerunners P	Forerunners S	L	Un-defined	△	Remarks
	1931 Sept.		*m s*	*m s*	*h m s*	*m s*	*h m*	°	
197*	25*	6	13 8*	24 18	23 47		.7		Sumatra.
198	25	18					.1		
199	25	21			.9		1.4		
200*	26*	20			13.5	26 33	.7		
201	28	18					.2		Faint preceding movement.
202	29	5			39.1		1.1		
203	29	10					.3		
204	30	11	23 28	30 26			.7	49	Sulaiman Range.

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NOTES

No. 7. July 5. 7^h. Forerunners masked by *L* of preceding shock; *P* possibly $45^m.6$. e_Z $51^m.7$ may be *P* of a further shock.

No. 12. July 12. 16^h. Pacific Ocean. *P* and *PP*, 62^m14^s, small. *S* larger but not very clearly marked. *PS* $70^m.8$; *SS* 75^m. *M* shortly after the beginning of *L*.

No. 28. July 21. 3^h. △ = ca. 135°. Small, but clearly marked phases which may be identified as follows: *P'* 55^m34^s; *PP* 58^m40^s; *PPP* $61^m.5$; S_cP_cS 62^m38^s; $\overline{S_cP_cP_cS}$ 65^m18^s; S_cP_cSP 68^m45^s; *PS* $70^m.0$; *PPS* $71^m.0$; *SS* $77^m.1$.

No. 56. Aug. 7. 2^h. Pacific Ocean. △ = ca. 115°. *P* quite small, read on *Z*. *PP* $31^m.2$, followed by much oscillatory movement. *PPP* $33^m.6$; $\overline{S_cP_cS}$ $37^m.0$; e_N $39^m.0$; *PS* 40^m42^s, followed by large movement; e_E $42^m.6$; *SSS* $47^m.1$, clearly marked by large oscillations; followed by irregular, slow oscillations; the beginning of *L* not certain.

No. 66. Aug. 10. 21^h. Altaï. *P* begins quite faintly 27^m7^s, movement increases 27^m20^s and continues to increase; very large amplitude 27^m55^s. Also gradually increasing movement in other phases. *PP* 29^m21^s; 40^s. *S* increases to very large amplitudes, S_N 34^m11^s; 21^s; 55^s; S_E $34^m.3^s$; 21^s; 45^s; 52^s; S_Z 34^m35^s. SS_N $37^m.8$; SS_E $38^m.2$. *L* earliest on *N*, 40^m. *M* outside range of paper; pens thrown off Wiechert *E* and *Z*. A few oscillations of very long period 23^h33^m.

No. 96. Aug. 15. 4^h. Badakshan. Forerunners small on *N*. 11^m41^s clearly marked on *E* and *Z*. *S* small. e_N 16^m21^s. *SS* $18^m.3$ large on *N*. *L* small, deep focus?

No. 105. Aug. 18. 14^h. Mongolia. Phases in forerunners clearly marked. Strong movement follows *SS*; the beginning of *L* uncertain. Very large *M* begin 46^m on all component records.

No. 121. Aug. 24. 21^h. Baluchistan. $e_{E,Z}$ $44^m.7$. *S* quite large, but the beginning not clearly marked. *e* 52^m6. *SS* large. On *N*, *L* begins about 59^m with waves of long period. On *E* and *Z*, *M* sets in abruptly 66^m.

No. 139. Aug. 27. 15^h Baluchistan. The beginning of *P* small, increase of movement 35^m51^s; sharp increase on *N* and *Z* 36^m29^s. *PP* 37^m29^s, clearly marked on *E* only. *S* largest on *E*; $e_{N,E}$ $43^m.4$, strong increase of movement, very large oscillations on *E*. eSS_E $45^m.7$, increases $46^m.2$; SS_N 45^m57^s. Large *M* begin on *N* 57^m, on *E* and *Z* 58^m. *L'* $18^h.2$.

Nos. 165-166. Sept. 9. 20^h. Marianne Islands region. Additional readings: 62^m34^s; $63^m.0$; $63^m.7$. 64^m43^s; 65^m0^s; 65^m47^s. The first 3 phases possibly belong to the first shock, the other 3 to the second; largest movement at $63^m.0$ and 65^m0^s. *SS* of the first shock $69^m.0$. *L* $1^h.4$.

No. 197. Sept. 25. 6^h. Sumatra; △ = ca. 95°. *PP* $17^m.0$. $\overline{S_cP_cS}$ 23^m47^s, on *E* only; *S* large and clearly marked on *N*. PS_E $25^m.7$. *SS* $31^m.0$.

No. 200. Sept. 26. 20^h. $13^m.5$ quite small, not on *Z* e_Z 15^m51^s. e_N $27^m.7$; e_E $32^m.5$.

No. 20. 1931.

Geodætisk Institut

Proviantgaarden, Copenhagen, Denmark.

Bulletin

of the seismological station

KØBENHAVN

$\varphi = 55°41'$ N. $\lambda = 12°27'$ E. $h = 13$ m.

Lithologic foundation: chalk.

No. 20. Oct.—Dec. 1931

Instruments:

Galitzin pendulums with galvanometric registration.

Constants:

Component	l	T_1	A_1	μ^2	T	k
	cm	sec	cm		sec	
N	12.5	12.62	100	−0.01	12.4	104
E	12.5	12.62	100	0.1	12.1	101
Z	14.4	11.56	100	0.0	10	90

Wiechert 1000 kg. horizontal seismograph.

Wiechert 1300 kg. vertical seismograph.

Constants:

Component	T	v	ϱ	V
	sec		mm	
N	9.7	4.6	0.6	225
E	9.5	4.1	0.8	195
Z	5.5	3.9	0.2	170

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

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No.	Date	Hour	Forerunners P	Forerunners S			L	Un-defined	△	Remarks
	1931 Oct.		m s	m s	h m s	m s	h m	h m	°	
1	1	12			8.5		.4			
2	2	14						.9		
3*	3*	19			32.9	35 7	1.1			Salomon Islands.
4	3	23					.0			Superposed on preceding shock.
5	3	23					.7			„ „ „ „
6*	5*	22	39 10*	*i* 45 22	*i* 42 0	48.6				Turkestan.
7	6	18					.2			
8	6	19					.4			
9	7	11					.5			Faint.
10	8	3					.0			
11	9	3					.9			
12	9	6					.8			
13	9	16					.2			
14*	10*	0			39 1	41 2	1.1			Pacific Ocean.
15	10	8					.1			
16	10	16	47.2	55 27					61	
17	12	4					.1			
18	13	5					.6			
19	14	21					.3			
20	17	15			56		1.3			
21	18	1			1		.7			
22	18	4			49 29	52.2				
23	18	7					.7			
24	20	16	4 46							Caspian Sea.
25	23	12					.2			
26	23	20			.5		1.2			
27	24	3						16		
28	24	5						.2		
29	24	12			55.8		1.3			Small preceding movement.
30	26	4			48 39	54.3	1.1			
31	26	12			21 40		.8			
32	26	15					.5			
33	27	2					.2			
34	28	6					.3			
35	29	9								Disturbed.
36	31	7					.8			
37	31	10					.9			
	Nov.									
38	1	13					.7			
39	1	19	5 13	15 7	15.4	20.2	.5		78	Japan.
40*	2*	0	44 54		48 15	61.3	1.2			Mexico.
41*	2*	10	*i* 15 0	25 3	*i* 18 3	30 2	40		80	China Sea.
42	2	17			23.2	32.9				*e* 39m.6. *L* and *L'* of long duration.
43	3	16					58			
44	4	18					.5			
45	5	12	28 3		29.9	*i* 39 32				*e* 37m.6. *P* quite small, uncertain.
46	18	3			51 45		1.9			
47	20	14			37 52	38.9	1.2			
48	23	23						.7		

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No.	Date	Hour	Forerunners P	Forerunners S			L	Un-defined	△	Remarks
	1931 Nov.		m s	m s	h m s	m s	h m	h m	°	
49	24	9					36			No Galitzin records.
50	25	15						.2		
	Dec.									
51	1	4					.8			Some preceding movement.
52	1	19						.6		*L* 19h.7. Some preceding movement;
53	2	22						.0		[possibly 2 shocks.
54	6	23						34		
55	14	20					.0			
56	18	10	2 45		13.3	14.7	.7			
57	21	11						.8		
58	22	13						.8		
59	30	1			31		37			
60	31	0			46 38	46.8				*P* between 36m and 37m; the begin-
61	31	18						12		[ning uncertain.

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NOTES

No. 3. Oct. 3. 19^h. Salomon Islands; $\triangle$ = ca. 130°. Strong record. Galitzin records almost unreadable owing to entanglement of traces of different lines. Strong microseismic movement. Several clearly marked pulses read on Wiechert records: e_Z 35^m39^s; $e_{E,Z}$ 36^m36^s; e_N 36^m49^s; 37^m45^s; $38^m.6$; $40^m.0$; $41^m.9$; 42^m41^s; $48^m.0$; $52^m.2$.

No. 6. Oct. 5. 22^h. Turkestan. Deep focus. Large and clearly marked phases in forerunners; *L* small. Additional readings: $e_{E,Z}$ 39^m55^s; e_Z 40^m23^s; $e_{N,E}$ $46^m.6$.

No. 14. Oct. 10. 0^h. Pacific Ocean; $\triangle$ = ca. 125°. Strong record. Additional readings: $42^m.1$; $42^m.4$; $46^m.0$; $48^m.0$; $52^m.4$; 58^m. *L* large, regular, of long duration.

No. 40. Nov. 2. 0^h. Mexico. The beginning of *P* small, not quite certain. *S* or $\overline{S_cP_cS}$ about $55^m.2$, not very clearly marked; increase of movement at pulse 55^m35^s.

No. 41. Nov. 2. 10^h. China Sea. Strong record. Phases clearly marked. $e_{N,E}$ $20^m.0$. *S* large on *E*, smaller on *N*; followed by large movement, *e* $25^m.7$.

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