

PRELIMINARY RESULTS OF OCEAN MAGNETIC OBSERVATIONS ON
THE CARNEGIE FROM COLOMBO, CEYLON, TO FREMANTLE,
WESTERN AUSTRALIA, AND LYTTELTON, NEW
ZEALAND, JULY TO OCTOBER, 1920.¹

By J. P. AULT, *Commanding the Carnegie.*

(Observers: J. P. Ault, H. F. Johnston, R. R. Mills, H. R. Grummann, and R. Pemberton.)

Date	Latitude	Long. East of Gr.	Carnegie Values			Chart Values				Chart Differences ²			
			Decl'n	Incl'n	Hor. Int.	Decl'n		Incl'n	H. In.	Decl'n		Incl'n	H. In. ³
						Brit.	U.S.			Brit.	U.S.		
1920					c.g.s.				c.g.s.				
July 24	6 36 N	79 50	2.8W	.....	.....	3.0W	2.6W	.....	.....	0.2 E	0.2W	.....	.....
25	5 01 N	80 04	2.9W	.....	.....	3.3W	2.8W	.....	.....	0.4 E	0.1W	.....	.....
25	4 36 N	80 26	.....	9.6 S	381	.....	.....	9.8 S	377	.....	.....	0.2 N	+4
25	4 34 N	80 50	3.1W	.....	.....	3.4W	3.0W	.....	.....	0.3 E	0.1W	.....	.....
26	4 27 N	82 30	2.9W	.....	.....	3.3W	2.9W	.....	.....	0.4 E	0.0	.....	.....
26	4 15 N	83 47	.....	10.9 S	381	.....	.....	10.9 S	380	.....	.....	0.0	+1
26	4 09 N	84 04	3.3W	.....	.....	3.2W	2.8W	.....	.....	0.1W	0.5W	.....	.....
27	3 31 N	85 52	2.7W	.....	.....	3.2W	2.8W	.....	.....	0.5 E	0.1 E	.....	.....
27	3 09 N	86 58	.....	13.6 S	384	.....	.....	12.8 S	382	.....	.....	0.8 S	+2
27	3 02 N	87 22	2.8W	.....	.....	3.0W	2.7W	.....	.....	0.2 E	0.1W	.....	.....
28	2 25 N	89 13	2.7W	.....	.....	2.8W	2.5W	.....	.....	0.1 E	0.2W	.....	.....
28	2 05 N	90 13	.....	16.4 S	384	.....	.....	15.1 S	382	.....	.....	1.3 S	+2
28	2 01 N	90 23	2.6W	.....	.....	2.6W	2.4W	.....	.....	0.0	0.2W	.....	.....
29	1 32 N	91 50	1.9W	.....	.....	2.4W	2.2W	.....	.....	0.5 E	0.3 E	.....	.....
29	1 32 N	92 28	.....	17.6 S	385	.....	.....	16.9 S	382	.....	.....	0.7 S	+3
30	1 15 N	93 07	1.9W	.....	.....	2.1W	1.9W	.....	.....	0.2 E	0.0	.....	.....
30	0 59 N	93 28	.....	19.0 S	383	.....	.....	17.6 S	382	.....	.....	1.4 S	+1
30	0 50 N	93 34	1.9W	.....	.....	2.0W	1.9W	.....	.....	0.1 E	0.0	.....	.....
31	0 02 N	94 04	2.0W	.....	.....	2.0W	1.9W	.....	.....	0.0	0.1W	.....	.....
31	0 20 S	94 03	.....	21.8 S	380	.....	.....	21.2 S	379	.....	.....	0.6 S	+1
31	0 30 S	94 04	1.9W	.....	.....	2.0W	2.0W	.....	.....	0.1 E	0.1 E	.....	.....
Aug. 1	1 55 S	94 07	.....	25.4 S	375	.....	.....	24.0 S	374	.....	.....	1.4 S	+1
1	2 01 S	94 07	2.1W	.....	.....	2.2W	2.1W	.....	.....	0.1 E	0.0	.....	.....
2	3 06 S	94 16	2.4W	.....	.....	2.3W	2.2W	.....	.....	0.1W	0.2W	.....	.....
2	3 39 S	94 29	.....	28.8 S	369	.....	.....	27.2 S	368	.....	.....	1.6 S	+1
2	3 46 S	94 36	2.4W	.....	.....	2.4W	2.3W	.....	.....	0.0	0.1W	.....	.....
3	4 37 S	95 03	2.4W	.....	.....	2.4W	2.4W	.....	.....	0.0	0.0	.....	.....
3	5 06 S	95 17	.....	31.7 S	362	.....	.....	30.9 S	360	.....	.....	0.8 S	+2
3	5 19 S	95 21	2.5W	.....	.....	2.5W	2.4W	.....	.....	0.0	0.1W	.....	.....
4	6 17 S	95 34	2.6W	.....	.....	2.7W	2.5W	.....	.....	0.1 E	0.1W	.....	.....

¹For previous table, see *Terr. Mag.*, v. 25, pp. 117-122.

²Charts used for comparison: U. S. Hydrographic Office Charts Nos. 1700, 1701, and 2406 for 1920; British Admiralty Charts Nos. 3776 and 3777 for 1917. The chart differences are obtained by subtracting chart values, derived as explained in previous sentence, from the observed Carnegie values. In order to explain the significance of the letters *E*, *W*, *N*, *S*, as affecting the application of the chart differences, it may be stated that *E* and *N* have been treated as being plus, *W* and *S* as minus, the chart difference being equal to the Carnegie value minus the chart value. The horizontal intensity is always regarded as positive, and the signs, plus and minus, have their usual significance. Secular corrections have been applied to declinations only.

³Expressed in units of third decimal C. G. S.

⁴Local disturbance off Cape Naturaliste, Australia.

Date	Latitude	Long. East of Gr.	Carnegie Values			Chart Values				Chart Differences ²			
			Decl'n	Incl'n	Hor. Int.	Decl'n		Incl'n	H. In.	Decl'n		Incl'n	H. In. ³
						Brit.	U.S.			Brit.	U.S.		
1920					c.g.s.				c.g.s.				
Aug. 4	6 38 S	95 37	.....	35.1 S	.355	.....	.....	33.7 S	.350	.....	.....	1.4 S	+5
4	6 50 S	95 37	2.7W	.....	.....	2.8W	2.6W	.....	.....	0.1 E	0.1W	.....	.....
5	7 43 S	95 36	2.9W	.....	.....	3.0W	2.8W	.....	.....	0.1 E	0.1W	.....	.....
5	8 12 S	95 31	.....	37.5 S	.347	.....	.....	36.4 S	.342	.....	.....	1.1 S	+5
5	8 21 S	95 26	3.0W	.....	.....	3.2W	3.0W	.....	.....	0.2 E	0.0	.....	.....
6	9 02 S	95 05	3.4W	.....	.....	3.5W	3.2W	.....	.....	0.1 E	0.2W	.....	.....
6	9 27 S	94 53	.....	39.7 S	.341	.....	.....	38.4 S	.336	.....	.....	1.3 S	+5
6	9 36 S	94 48	3.6W	.....	.....	3.8W	3.5W	.....	.....	0.2 E	0.1W	.....	.....
7	10 16 S	94 23	4.0W	.....	.....	4.2W	3.8W	.....	.....	0.2 E	0.2W	.....	.....
8	11 41 S	93 22	5.0W	.....	.....	5.1W	4.6W	.....	.....	0.1 E	0.4W	.....	.....
8	12 22 S	92 55	.....	44.7 S	.322	.....	.....	44.0 S	.318	.....	.....	0.7 S	+4
9	14 11 S	91 07	7.0W	.....	.....	7.2W	6.3W	.....	.....	0.2 E	0.7W	.....	.....
9	14 56 S	90 24	.....	48.5 S	.305	.....	.....	47.0 S	.304	.....	.....	1.5 S	+1
9	15 12 S	90 10	7.9W	.....	.....	8.0W	7.2W	.....	.....	0.1 E	0.7W	.....	.....
10	16 53 S	88 30	9.5W	.....	.....	9.4W	8.7W	.....	.....	0.1W	0.8W	.....	.....
10	17 44 S	87 45	.....	51.8 S	.286	.....	.....	51.2 S	.284	.....	.....	0.6 S	+2
10	17 56 S	87 35	10.2W	.....	.....	10.2W	9.9W	.....	.....	0.0	0.3W	.....	.....
11	19 32 S	86 04	11.9W	.....	.....	11.6W	11.5W	.....	.....	0.3W	0.4W	.....	.....
11	20 24 S	85 26	.....	54.7 S	.267	.....	.....	54.1 S	.266	.....	.....	0.6 S	+1
11	20 33 S	85 22	13.0W	.....	.....	12.7W	12.4W	.....	.....	0.3W	0.6W	.....	.....
12	21 58 S	84 02	14.1W	.....	.....	13.9W	14.0W	.....	.....	0.2W	0.1W	.....	.....
12	22 38 S	83 20	.....	56.8 S	.251	.....	.....	56.3 S	.252	.....	.....	0.5 S	-1
12	22 48 S	83 10	14.8W	.....	.....	14.9W	14.6W	.....	.....	0.1 E	0.2W	.....	.....
13	24 05 S	82 03	16.4W	.....	.....	16.0W	15.9W	.....	.....	0.4W	0.5W	.....	.....
13	24 39 S	81 22	.....	58.9 S	.239	.....	.....	58.2 S	.237	.....	.....	0.7 S	+2
13	24 48 S	81 10	17.2W	.....	.....	16.7W	16.5W	.....	.....	0.5W	0.7W	.....	.....
14	25 54 S	79 39	18.2W	.....	.....	17.8W	17.4W	.....	.....	0.4W	0.8W	.....	.....
14	26 15 S	79 08	.....	60.1 S	.228	.....	.....	59.8 S	.231	.....	.....	0.3 S	-3
14	26 20 S	78 53	18.8W	.....	.....	18.2W	17.9W	.....	.....	0.6W	0.9W	.....	.....
15	25 39 S	80 15	18.6W	.....	.....	17.5W	17.1W	.....	.....	1.1W	1.5W	.....	.....
16	26 55 S	78 27	19.6W	.....	.....	18.7W	18.4W	.....	.....	0.9W	1.2W	.....	.....
16	27 13 S	77 56	.....	60.3 S	.224	.....	.....	60.3 S	.220	.....	.....	0.0	+4
16	27 18 S	77 46	19.8W	.....	.....	19.1W	18.7W	.....	.....	0.7W	1.1W	.....	.....
17	27 55 S	76 56	20.6W	.....	.....	19.5W	19.4W	.....	.....	1.1W	1.2W	.....	.....
17	28 13 S	76 28	.....	61.0 S	.217	.....	.....	60.9 S	.214	.....	.....	0.1 S	+3
17	28 16 S	76 24	20.9W	.....	.....	19.8W	19.8W	.....	.....	1.1W	1.1W	.....	.....
18	29 05 S	75 18	20.8W	.....	.....	20.3W	20.2W	.....	.....	0.5W	0.6W	.....	.....
18	29 26 S	74 51	.....	61.4 S	.213	.....	.....	61.6 S	.208	.....	.....	0.2 N	+5
18	29 39 S	74 37	22.4W	.....	.....	20.6W	20.5W	.....	.....	1.8W	1.9W	.....	.....
19	30 41 S	74 05	.....	62.2 S	.207	.....	.....	62.2 S	.202	.....	.....	0.0	+5
19	30 53 S	74 04	23.2W	.....	.....	21.8W	21.3W	.....	.....	1.4W	1.9W	.....	.....
20	32 18 S	75 40	24.8W	.....	.....	23.5W	23.4W	.....	.....	1.3W	1.4W	.....	.....
20	32 43 S	76 06	.....	63.7 S	.203	.....	.....	63.7 S	.198	.....	.....	0.0	+5
20	32 55 S	76 22	25.1W	.....	.....	24.3W	24.1W	.....	.....	0.8W	1.0W	.....	.....
21	33 38 S	78 41	25.5W	.....	.....	25.2W	25.1W	.....	.....	0.3W	0.4W	.....	.....
21	33 50 S	79 47	.....	65.0 S	.203	.....	.....	64.8 S	.198	.....	.....	0.2 S	+5
21	33 54 S	80 05	26.6W	25.6W	25.2W	1.0W	1.4W
22	34 27 S	82 40	26.2W	26.0W	25.8W	0.2W	0.4W
22	34 44 S	83 50	66.2 S	.199	65.9 S	.198	0.3 S	+1

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						Brit.	U.S.			Brit.	U.S.		
1920	° /	° /	°	°	c.g.s.	°	°	°	c.g.s.	°	°	°	
Aug. 22	34 45 S	84 06	26.1W	26.3W	25.8W	0.2 E	0.3W
23	35 01 S	86 23	25.5W	25.9W	25.1W	0.4 E	0.4W
23	35 07 S	87 37	.....	67.2 S	.201	.....	.....	66.6 S	.200	.....	.....	0.6 S	+1
23	35 08 S	87 50	25.7W	.....	.....	25.6W	24.9W	.....	.....	0.1W	0.8W	.....	.....
24	35 15 S	90 38	24.7W	.....	.....	24.4W	24.0W	.....	.....	0.3W	0.7W	.....	.....
24	35 16 S	90 58	23.9W	.....	.....	24.2W	23.9W	.....	.....	0.3 E	0.0	.....	.....
24	35 23 S	92 12	.....	68.0 S	.202	.....	.....	67.7 S	.202	.....	.....	0.3 S	0
24	35 27 S	92 54	23.6W	.....	.....	23.4W	23.1W	.....	.....	0.2W	0.5W	.....	.....
25	35 37 S	94 48	21.9W	.....	.....	22.4W	22.2W	.....	.....	0.5 E	0.3 E	.....	.....
25	35 48 S	95 49	.....	68.7 S	.202	.....	.....	68.2 S	.204	.....	.....	0.5 S	-2
25	35 52 S	96 03	21.8W	.....	.....	21.9W	21.8W	.....	.....	0.1 E	0.0	.....	.....
26	35 39 S	98 28	19.9W	.....	.....	20.0W	19.3W	.....	.....	0.1 E	0.6W	.....	.....
26	35 26 S	99 45	.....	68.8 S	.205	.....	.....	68.4 S	.208	.....	.....	0.4 S	-3
27	35 08 S	102 11	16.2W	.....	.....	16.4W	16.1W	.....	.....	0.2 E	0.1W	.....	.....
27	35 00 S	103 20	.....	68.6 S	.208	.....	.....	68.2 S	.213	.....	.....	0.4 S	-5
27	34 56 S	103 33	15.6W	.....	.....	15.4W	15.0W	.....	.....	0.2W	0.6W	.....	.....
28	34 42 S	105 58	13.1W	.....	.....	13.3W	12.9W	.....	.....	0.2 E	0.2W	.....	.....
28	34 33 S	107 24	.....	68.9 S	.211	.....	.....	68.2 S	.217	.....	.....	0.7 S	-6
28	34 29 S	107 41	12.3W	.....	.....	11.6W	11.5W	.....	.....	0.7W	0.8W	.....	.....
29	33 41 S	110 27	.....	67.7 S	.224	.....	.....	67.4 S	.224	.....	.....	0.3 S	0
29	33 36 S	110 39	9.2W	.....	.....	8.8W	8.7W	.....	.....	0.4W	0.5W	.....	.....
30	32 32 S	112 38	6.6W	.....	.....	7.0W	6.8W	.....	.....	0.4 E	0.2 E	.....	.....
30	32 18 S	113 25	.....	66.1 S	.236	.....	.....	66.2 S	.234	.....	.....	0.1 N	+2
30	32 16 S	113 41	6.1W	.....	.....	6.3W	6.2W	.....	.....	0.2 E	0.1 E	.....	.....

NOTES ON TRIP FROM COLOMBO TO FREMANTLE.

We left Colombo the morning of July 24 and were towed ten miles off shore against the prevailing southwest monsoon. At noon we let go the tugboat, started our own engine and proceeded southeasterly under fore-and-aft sails, close hauled to clear the southwest point of Ceylon. At midnight the wind hauling more to the westward, the engine was stopped and we proceeded under full sail.

Considerations of prevailing winds for July and August made it seem desirable to cross the Equator in longitude 95° east, so it was decided to make easting north of "the line" instead of south. Accordingly on July 25 our course was changed to an easterly direction and a good run was made in the southwest monsoon until July 29, when this wind died out. The extent of the calm belt encountered next proved the wisdom of taking the northerly course. During the nine days from July 29 to August 7, the vessel made over 800 miles under her engine alone through a continuous calm. Instead of picking up the southeast trade wind near latitude 3° south as expected, no wind was found until we had reached the latitude of 10° south. On the morning of August 7 the sea became rough and the engine was stopped.

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			Decl'n	Incl'n	Hor. Int.	Decl'n		Incl'n	H. In.	Decl'n		Incl'n	H. In. ³
						Brit.	U.S.			Brit.	U.S.		
1920					c.g.s.				c.g.s.				
Oct.	1	32 12 S	115 20	4.9W	.....	5.3W	5.5W	.....	.....	0.4 E	0.6 E	.....	.....
	2	33 09 S	114 43	4.8W	.....	6.3W	6.4W	.....	.....	1.5 E	1.6 E	.....	.....
	3	35 15 S	115 57	6.3W	.....	6.7W	6.7W	.....	.....	0.4 E	0.4 E	.....	.....
	3	35 24 S	116 14	.....	68.6 S .215	.....	.....	68.2 S	.220	.....	.....	0.4 S	-5
	3	35 27 S	116 19	6.9W	.....	6.6W	6.7W	.....	.....	0.3W	0.2W	.....	.....
	4	36 42 S	116 56	7.3W	.....	7.0W	7.0W	.....	.....	0.3W	0.3W	.....	.....
	4	37 50 S	117 42	.....	70.1 S .201	.....	.....	70.2 S	.206	.....	.....	0.1 N	-5
	4	38 05 S	117 52	7.6W	.....	7.2W	7.4W	.....	.....	0.4W	0.2W	.....	.....
	5	39 50 S	119 07	7.9W	.....	7.4W	7.4W	.....	.....	0.5W	0.5W	.....	.....
	5	41 01 S	119 58	.....	72.5 S .184	.....	.....	72.5 S	.186	.....	.....	0.0	-2
	5	41 19 S	120 10	8.1W	.....	7.7W	7.6W	.....	.....	0.4W	0.5W	.....	.....
	6	42 52 S	121 08	8.7W	.....	8.3W	8.0W	.....	.....	0.4W	0.7W	.....	.....
	6	43 21 S	122 10	.....	74.3 S .167	.....	.....	74.3 S	.168	.....	.....	0.0	-1
	6	43 24 S	122 21	8.0W	.....	7.6W	7.5W	.....	.....	0.4W	0.5W	.....	.....
	7	44 18 S	125 12	6.2W	.....	5.9W	6.0W	.....	.....	0.3W	0.2W	.....	.....
	7	44 30 S	126 25	.....	74.6 S .167	.....	.....	74.7 S	.164	.....	.....	0.1 N	+3
	7	44 30 S	126 26	4.2W	.....	5.1W	5.0W	.....	.....	0.9 E	0.8 E	.....	.....
	8	44 56 S	126 47	.....	75.0 S .161	.....	.....	75.0 S	.163	.....	.....	0.0	-2
	8	44 58 S	127 51	4.0W	.....	4.2W	4.2W	.....	.....	0.2 E	0.2 E	.....	.....
	8	45 05 S	128 00	4.3W	.....	4.2W	4.1W	.....	.....	0.1W	0.2W	.....	.....
	9	46 08 S	129 32	3.2W	.....	3.4W	3.5W	.....	.....	0.2 E	0.3 E	.....	.....
	9	46 51 S	130 41	.....	76.7 S .148	.....	.....	76.2 S	.150	.....	.....	0.5 S	-2
	10	48 31 S	134 17	0.0	.....	0.3W	0.4W	.....	.....	0.3 E	0.4 E	.....	.....
	10	48 55 S	135 18	.....	77.1 S .144	.....	.....	77.5 S	.140	.....	.....	0.4 N	+4
	11	49 46 S	137 55	2.5 E	.....	1.4 E	1.6 E	.....	.....	1.1 E	0.9 E	.....	.....
	11	49 49 S	138 02	2.2 E	.....	1.5 E	1.7 E	.....	.....	0.7 E	0.5 E	.....	.....
	11	50 02 S	139 10	.....	77.9 S .137	.....	.....	78.0 S	.136	.....	.....	0.1 N	+1
	11	50 03 S	139 22	3.4 E	.....	2.7 E	3.0 E	.....	.....	0.7 E	0.4 E	.....	.....
	12	50 20 S	142 25	6.8 E	.....	5.5 E	5.8 E	.....	.....	1.3 E	1.0 E	.....	.....
	12	50 21 S	144 08	.....	77.6 S .138	.....	.....	77.7 S	.138	.....	.....	0.1 N	0
	12	50 20 S	144 22	8.2 E	.....	7.5 E	7.4 E	.....	.....	0.7 E	0.8 E	.....	.....
	13	50 30 S	147 05	10.4 E	.....	9.6 E	9.5 E	.....	.....	0.8 E	0.9 E	.....	.....
	13	50 35 S	148 31	.....	77.7 S .140	.....	.....	76.9 S	.143	.....	.....	0.8 S	-3
	13	50 34 S	148 52	12.0 E	.....	10.9 E	10.8 E	.....	.....	1.1 E	1.2 E	.....	.....
	14	49 56 S	151 09	13.1 E	.....	12.3 E	12.3 E	.....	.....	0.8 E	0.8 E	.....	.....
	14	49 38 S	152 36	.....	75.9 S .155	.....	.....	75.6 S	.156	.....	.....	0.3 S	-1
	14	49 31 S	152 53	13.7 E	.....	13.3 E	13.0 E	.....	.....	0.4 E	0.7 E	.....	.....
	15	47 58 S	156 16	.....	74.1 S .173	.....	.....	74.1 S	.173	.....	.....	0.0	0
	15	47 56 S	156 36	14.6 E	.....	14.6 E	14.7 E	.....	.....	0.0	0.1W	.....	.....
	16	47 34 S	160 36	.....	73.1 S .183	.....	.....	73.2 S	.183	.....	.....	0.1 N	0
	16	47 38 S	160 56	16.2 E	.....	16.1 E	16.2 E	.....	.....	0.1 E	0.0	.....	.....
	17	47 59 S	163 46	16.9 E	.....	17.0 E	17.1 E	.....	.....	0.1W	0.2W	.....	.....
	17	48 00 S	165 24	.....	72.9 S .185	.....	.....	72.6 S	.186	.....	.....	0.3 S	-1
	17	47 59 S	165 53	18.4 E	.....	17.5 E	17.6 E	.....	.....	0.9 E	0.8 E	.....	.....
	18	47 44 S	168 28	18.4 E	.....	17.9 E	17.9 E	.....	.....	0.5 E	0.5 E	.....	.....
	18	47 34 S	168 43	18.3 E	.....	17.9 E	18.0 E	.....	.....	0.4 E	0.3 E	.....	.....
	18	46 42 S	169 54	.....	70.8 S .204	.....	.....	71.2 S	.200	.....	.....	0.4 N	+4
	18	46 18 S	170 17	18.2 E	.....	17.7 E	17.8 E	.....	.....	0.5 E	0.4 E	.....	.....
	19	45 41 S	171 12	18.0 E	.....	17.6 E	17.6 E	.....	.....	0.4 E	0.4 E	.....	.....
	19	45 22 S	171 38	.....	69.7 S .210	.....	.....	69.8 S	.210	.....	.....	0.1 N	0
	19	45 18 S	171 46	18.0 E	.....	17.5 E	17.6 E	.....	.....	0.5 E	0.4 E	.....	.....
	20	44 42 S	172 30	17.6 E	.....	17.4 E	17.3 E	.....	.....	0.2 E	0.3 E	.....	.....
	20	44 25 S	172 51	.....	68.7 S .218	.....	.....	68.7 S	.218	.....	.....	0.0	0
	20	44 16 S	173 03	17.6 E	.....	17.3 E	17.3 E	.....	.....	0.3 E	0.3 E	.....	.....

From the afternoon of August 7 until August 19, we had a heavy southeast trade wind, which unexpectedly continued until the latitude of 31° south was reached. This run put us about 600 miles off our projected route, but fortunately gave us two crossings of the 1911 *Carnegie* track in a region where the annual change in the magnetic declination is quite large.

For five days after the southeast trade the wind held from a northeasterly direction. On August 24 it shifted to north and northwest in a gale with rapidly falling barometer and held at west after the barometer ceased falling and began to rise. This gale moderated to a strong breeze on August 25 and continued to blow from the westward until August 28, when the wind shifted to the north and began another gale, which continued until August 30. We reached Fremantle at 10:30 P. M. August 31, going the last eight hours under our engine with calms and against head winds.

The total distance traversed was 5,650 miles, which gives a daily average of 147 miles for the 38.5 days at sea.

NOTES ON THE TRIP FROM FREMANTLE TO LYTTELTON.

After a delay of one day spent in preparing records ready for the mail and in securing two seamen needed to fill the ship's complement, we left Fremantle on October 1 at 10:20 A. M., and were towed well out against a light head wind. During the night the northwest and west-northwest wind together with a southerly current set the vessel well in toward Cape Naturaliste, so that by eight o'clock on October 2 we were only 10 miles off the Cape. A gale from the west was blowing at the time with heavy squalls, making it uncertain that the vessel could clear Cape Leeuwin. It was decided to run the engine and proceed, trusting that the wind would not shift ahead until we got clear of the Cape. The engine held the vessel up to her course very well, probably overcoming a point of lee-way.

We were thus skirting the coast at a distance of about 10 miles from 8° until 21° , the wind shifting ahead just slowly enough to allow us to keep a clear course with careful steering, as the direction of the coast line changed from S by W to SSE. We cleared the dangerous point of Cape Leeuwin at a distance of three miles. The gale died down to a calm during the night, as we proceeded on our way south into the cold and stormy region of the high latitudes.

On October 5 the next gale began from the northeast and continued with fog, mist and rain until October 7, shifting through west to southwest.

Another short gale blew from the northwest on the night of October 10. A display of *Aurora Australis* was visible during the entire night of October 10, 1920, and again on October 11, in the form of a series of arches of white light stretched across the southern sky, with white vertical streamers extending up to the zenith.

At 8^h 15^m October 12, the vessel was within one mile of the *charted position of the Royal Company Islands*. Stieler's Atlas gives the position as 50° 24' S, 142° 45' E; H. R. Mill gives 50° 15' S and 142° 45' E, and Bartholomew gives 50° 18' S and 143° 00' E; the mean of these, 50° 20' S and 142° 50' E, was the position assumed. Nothing was in sight for a radius of 40 miles with very good visibility. The *Carnegie* sailed eastward all day at about 50° 20' south latitude and there were no signs of land. These islands have been searched for unsuccessfully by several navigators and they might well be eliminated from the charts. Our own experience in these latitudes in 1915-1916 showed the ease with which icebergs could be taken for land, when seen at distances even less than 5 miles. For several days before reaching the position given for the Royal Company Islands, birds were particularly numerous, albatross, molly-mawks, petrels, cape-pigeons, etc., and penguins were heard near the vessel at night. Floating kelp was passed in considerable quantities. But these indications cannot be taken always as signs of the proximity of land, as has often been done by earlier navigators in confirmation of their reports of new islands found.

Our heaviest weather began on October 12, a westerly wind developing into a gale, shifting to northwest, back to southwest, again to northwest, and back again to southwest on October 15, moderating at south on October 16, and maintaining a force of 7 to 9 during the entire five days. The heavy wind and sea from the northwest prevented our making the northing necessary for a passage through Cook Strait useful, so it was decided to proceed to Lyttelton by way of the Snares south of South Island, a much easier, safer, and direct route.

The Snares were picked up on October 17, as calculated, and anchor was dropped in Lyttelton Harbor at 3^h 15^m, A. M., of October 21. Owing to calms and head winds the engine was operated for two days before arrival at Lyttelton. The last 50 miles were made running before a heavy southeast wind that came out of a practically clear sky, within one minute of the dying out of the northeast wind that had been blowing for several hours.

The usual meteorological conditions for these latitudes were experienced, but a fairly complete program of observations was carried out in spite of fogs, storms, and heavy seas. Declination observations were made daily and usually twice a day. The total number of miles traversed from Fremantle to Lyttelton was 3,157. Hence, the average daily run for the 19.7 days at sea was 160.3 nautical miles.