SECT. II.—OTHER SELECTED PAPERS.

(Paper No. 3252.)

“Notes on the Height of Waves at Peterhead, N.B.”

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At the Engineering Conference held in June, 1899, the Author contributed a short Paper¹ with a view to introducing the subject of waves and their effect on breakwaters, and it is thought that a short notice of the height of waves at Peterhead, during the great storm of 15 and 16 February, 1900, may be of interest as a supplement to it.

Unfortunately there are no instruments at Peterhead by which wind-velocities can be reliably ascertained; but the velocities given in the following Table were recorded at the Meteorological

PARTICULARS OF STORM AS RECORDED AT THE METEOROLOGICAL STATION,
DEERNES, ORKNEY.

Date.	Time.	Velocity of Wind.	Direction.
		Miles per Hour.	
15th February, 1900	2 to 3 p.m.	60	S.E. by S.
" " "	3 " 4 "	57	S.E.
" " "	4 " 5 "	63	S.E.
" " "	5 " 6 "	67	S.E.
" " "	6 " 7 "	65	S.E. by E.
" " "	7 " 8 "	73	S.E. by E.
" " "	8 " 9 "	75	E.S.E.
" " "	9 " 10 "	70	E.S.E.
" " "	10 " 11 "	75	E.S.E.
" " "	11 " 12 "	76	E.S.E.
16th February, 1900	12 " 1 a.m.	79	E.S.E.
" " "	1 " 2 "	74	E. by S.
" " "	2 " 3 "	76	E. by S.
" " "	3 " 4 "	73	E.S.E.
" " "	4 " 5 "	77	E.S.E.
" " "	5 " 6 "	89	E.S.E.
" " "	6 " 7 "	80	E.S.E.
" " "	7 " 8 "	81	E.S.E.
" " "	8 " 9 "	52	S.S.E.

¹ Minutes of Proceedings Inst. C.E., vol. cxxxviii. p. 398.

station at Deerness, Orkney. Deerness is about 100 miles north of Peterhead, and a comparison of notes and of barometric pressures seems to indicate that there was no material difference in the violence of the storm at the two places.

Although on the three days preceding the storm the wind was off shore (*viz.*, W. to S.W.), and blowing with only the force of a gentle breeze, a heavy ground swell, doubtless the precursor of the advancing storm, was setting into Peterhead Bay. By the morning of 15 February, the wind had backed to S.S.E., and had increased in force to a strong breeze, which caused the sea to rise rapidly, until on Friday, the 16th February, when the wind velocity had reached its maximum, the waves attained a height which the Author had not before witnessed. On the afternoon of the 16th, when the wind had somewhat abated, sights along the breakwater were taken with the view of ascertaining the height of the waves as they ran into the Bay, between the breakwater end and the opposite shore (Keith Inch). The depth of water along the line of sight was about 10 fathoms to $10\frac{1}{2}$ fathoms. The sights, which were 6 feet 6 inches high and 120 feet apart, were on the coping of the breakwater, the level of which is 22 feet above low-water of spring tides. At the time of observation the tide-gauge registered 9 feet; the line of sight was therefore 19 feet 6 inches above the still-water level. The waves were irregular in respect of height and length as well as of period, but wave after wave passed, having its crest, quite unbroken, at least 3 feet above the line of sight, and therefore fully 22 feet 6 inches above the still-water level. The periods of the waves varied between about 13 seconds and 17 seconds, and their lengths were probably between 500 feet and 700 feet, but the Author had no means of accurately ascertaining this. Assuming the troughs of the waves to have been as far below the still-water level as their crests were above it, the height of the waves would have been 45 feet; but the apparent flatness of the trough curve, compared with that of the crest, seemed to indicate that the height of the crest above, and the depth of the trough below the still-water level were not identical. There can be little doubt that the crests of the waves were to some extent raised by the friction of the sea-bed, and since the volume of water above the still-water level must correspond with that of the trough below it, it is probable that the height of the waves, trough to crest, closely approximated to 40 feet, as will be seen on reference to the accompanying diagrams, *Figs. 1.*

On a line across the heads of Peterhead Bay, the general depth

at low-water is about 10 fathoms. The 30-fathom line approaches to within 2 miles of the shore, and the water gradually deepens to 50 fathoms at the "Buchan Deeps," 12 miles off. A depth of 40 fathoms to 50 fathoms is then maintained in a south-easterly direction for about 200 miles, when the water gradually shoals towards the Danish coast, which is the limit of Peterhead's

Figs. 1.

exposure in that direction, and represents a fetch of about 400 miles. It will thus be seen that the physical conditions affecting Peterhead are such as to favour the propagation of the exceptionally heavy seas which are experienced there.

The Paper is accompanied by a drawing, from which the Figure in the text has been prepared.