ON SOME TIDE OBSERVATIONS AT HOBART DURING FEBRUARY AND MARCH, 1889.

By A. Mault.

Wishing, primarily in connection with the obtaining of necessary information for purposes connected with the drainage of Hobart, and secondarily, to fix the mean sea level for geodetic and engineering matters, to get a series of tidal observations, I spoke to Captain Oldham, of H.M.S. "Egeria," on the subject and he at once arranged to fix the automatic tide gauge of his ship on the New Wharf, and to have observations taken for as long a period as the sojourn at Hobart permitted. I am indebted to him for the accompanying remarks and tables of observations. To enable him to connect his observations with the level of some permanent object on shore, I took the levels from the town datum mark fixed to one of the steps of the Town Hall to the graduated staff fixed at the New Wharf in connection with the gauge. In his letter to me enclosing the remarks and tables, Captain Oldham says :—" From these observations the ' mean "tide level' is 8ft. 2·7 inches on the gauge, or 35·255 feet " below the datum mark on the Town Hall.

" Please note that these observations are only for one " month, and that, as probably the mean tide level varies at " different seasons, to get satisfactory results, a year's " observations should be obtained—this could easily be done " with an automatic gauge."

I am glad to say that this will be done, as the Hobart Marine Board is taking the necessary steps to procure and fix such a gauge. When it arrives I shall be happy to fix the graduated staff so as to coincide with the datum of Captain Oldham's observations.

The following are Captain Oldham's remarks and observations :—

"REMARKS ON TIDES OBSERVED AT HOBART.
February and March, 1889.

1. The tides are subject to a large diurnal inequality; the highest high water is followed by the lowest low water, the tide then rises to a lesser high water, and falls to a lesser low water.

2. With the moon's declination north, the higher high water follows the superior transit of the moon; with the moon's declination south the higher high water succeeds the inferior transit.

3. The greatest range of tide appears to occur about two days after the moon has reached its greatest north or south declination, the least range when the declination is zero.

4. H.W.F. & C. occurs at Hobart at 8h. 15min. Springs rise $\left\{ \begin{array}{l} 3\frac{3}{4} \text{ to } 4\frac{1}{2} \text{ feet,} \\ \text{and 2 feet.} \end{array} \right\}$ Neaps $2\frac{1}{2}$ feet.

REGISTER of TIDES observed at HOBART in the Month of FEBRUARY, 1889.

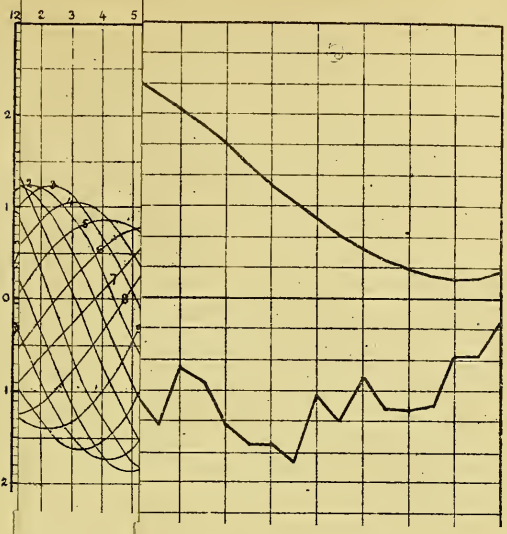| Day		High Water		Moon's Transit	Bar at H.W.	Low Water		Bar at L.W.	Wind	
		Time.	Height.			Time.	Height.		Direction.	Force.
		H. M.	F. I.	H. M.	Ins.	H. M.	F. I.	Ins.		
4	A M.	11·00	9·8½	..	29·85	..	..	..	W.N.W.	1
	P.M.	..	..	3·24	..	5·45	7·3	29·88	S.E.	3 to 4
5	A.M.	0·20	9·5	..	29·94	6·25	8·0	29·95	S.S.E.	1 to 3
	P.M.	11·20	8·9	4·10	30·05	6·25	6·11½	30·07	S.S.E.	4
6	A.M.	0·40	8·9	..	30·05	7·00	7·7	29·98	S.S.E.	3 to 4
	P.M.	0·30	8·3	4·53	29·93	6·30	7·4	29·83	South	3
7	A.M.	0·0	8·7		29·81	8·5	7·8	29·83	South	3
	P.M.									
8	A.M.									
	P.M.		Not observed.							
9	A.M.	3·00	9·0	..	30·22	10·20	6·5½	30·24	S.S.W.	1
	P.M.	4·00	7·8	7·6	30·24	7·30	7·4	30·24	S.E.	1 to 2
10	A.M.	3·20	9·3	..	30·05	10·20	6·10	30·05	Calm	0
	P.M.	5·8	8·4	7·52	30·08	8·50	7·11	30·01	S.E.	2 to 3
11	A.M.	3·25	9·4½	..	30·17	11·20	6·7	30·25	N.N.W.	1
	P.M.	5·40	8·0½	8·40	30·20	10·00	7·7	30·20	E.S.E.	2
12	A.M.	4·50	9·5½	..	30·18	12·05	6·8	30·15	N.N.W.	3
	P.M.	6·35	8·1	9·30	30·15	10·35	7·9	30·15	W.N.W.	4 to 6
13	A.M.	5·40	9·8½	..	29·83	..	..	..	S.S.E.	2
	P.M.	7·10	9·0	10·21	29·63	00·00	7·1	29·68	N.N.W.	3
14	A.M.	5·00	10·2	..	29·78	11·15	8·7	29·73	W.N.W.	4 to 6
	P.M.	7·55	8·6½	11·12	29·92	1·48	6·8½	29·89	N.N.W.	2
15	A.M.	6·40	9·8½	..	29·92	11·35	7·10½	29·95	W.N.W.	2
	P.M.	9·10	8·7	..	29·72	1·52	6·7	29·94	W.N.W.	1 to 3
16	A.M.	7·10	10·1	00·2	29·85	0·20	8·2	29·73	North	2
	P.M.	9·45	8·5	..	30·14	2·00	6·6½	30·01	S.W.	1 to 2
17	A.M.	8·30	9·1	00·52	30·27	1·40	7·8½	30·19	N.W.	1
	P.M.	10·25	8·0½	..	30·11	3·25	5·10	30·21	S.S.E.	3
18	A.M.	8·50	9·7	1·42	29·71	2·36	7·6½	29·74	N.W. by W.	1 to 2
	P.M.	11·00	9·2½	..	29·87	3·50	6·6½	29·74	W.N.W.	2 to 3
19	A.M.	9·40	9·4	2·28	30·08	4·20	8·0½	29·94	W.S.W.	2 to 5
	P.M.	11·35	8·7	..	30·25	4·40	6 7	30·20	North	1
20	A.M.	11·10	8·6	3·18	30·18	5·50	6·11	30·22	N.N.W.	1
	P.M.	..	..	..	..	5·52	6·5	30·14	S. by E.	1
21	A.M.	0·20	8·10	4·8	30·05	6·52	7·1	29·99	W.N.W.	1 to 2
	P.M.	0·30	9·1	..	29·91	6·30	7·5	29·80	S.E.	2
22	A.M.	0·40	9·10	5·0	29·81	7·40	7·0	29·87	S.W.	1
	P.M.	1·20	8·9	.	29·96	7·15	7·3	29·92	S.E.	2
23	A.M.	1·35	9·7	5·55	30·06	8·40	6·5	30·07	N.W.	1
	P.M.	2·50	8·7	..	30·03	7·45	7·8	29·99	S.E.	1
24	A.M.	2·30	10·1	6·55	29·67	9·40	6·11	29·50	N.N.W.	3 to 4
	P.M.	4·15	9·3	..	29·59	8·40	8·6	29·70	W.N.W.	4 to 6
25	A.M.	2·40	10·7	7·50	29·79	10·40	6·5	29·98	W.N.W.	1 to 3
	P.M.	4·55	8·11	..	29·96	9·35	8·2	29·98	N.N.W.	1 to 3
26	A.M.	4·00	10·4	8·51	29·93	11·15	6·4½	29·87	N.N.W.	1 to 2
	P.M.	6·15	9·2	..	29·67	10·15	8·4	29·51	North	2 to 3
27	A.M.	4·35	11·0	9·45	29·40	..	..	..	—	—
	P.M.	7·5	9·6	..	29·50	00·30	6·10	29·50	W.N.W.	2 to 4
28	A.M.	5·35	10·10	10·45	29·65	11·45	8·7½	29·54	North	5 to 6
	P.M.	8·5	8·6	..	30·29	1·25	6·4	30·15	W.S.W.	2

MONTH of MARCH.

Day		Time.	Height.	Moon's Transit	Bar at H.W.	Time.	Height.	Bar at L.W.	Direction.	Force.
1	A.M.	7·0	9·6½	11·36	30·32	0·20	7·6½	30·33	North	1
	P.M.	9·0	8·6	..	30·25	2·15	5·11	30·28	W.N.W.	2
2	A.M.	8·5	9·6	..	30·20	1·30	7·6	30·22	N.N.W.	3 to 4
	P.M.	9·48	9·0	0·27	29·99	3·10	6·8	30·05	S by W.	1
3	A.M.	8·40	9·8	..	29·97	2·50	8·1	29·92	N.W.	1
	P.M.	10·30	8·10	1·14	30·11	3·50	7·0	30·02	S.E.	1
4	A.M.	10·10	9·1	..	30·08	4·5	7·6	30·10	Calm	0
	P.M.	11·15	9·2	2·0	29·84	4·25	7·3	29·87	N.W.	3 to 4
5	A.M.	11·00	9·4	..	29·63	5·20	7·9	29·47	N.W.	4
	P.M.	11·35	9·9	2·43	29·60	4·55	8·2	29·61	N.W.	3 to 4
6	A.M.	11·20	9·4	..	29·63	5·30	8·1	29·60	N.W.	2 to 3
	P.M.	..	..	..	..	..	..	..	—	—

Mean Tide Level from one month's observations is 8ft. 2·7in. on gauge, or 35·255ft. below datum on Town Hall.

For the purpose of more readily comprehending the information contained in these observations, I have prepared diagrams—the greater part drawn to scale—and setting forth :—

 1st. The curve of tidal action for every day during which observations were taken, from the 4th February to the 6th March, showing the levels of high and low water in comparison with mean tide level, and the times at which they occurred.

 2nd. The moon's course so as to show the times of superior and inferior transit of the moon's phases and apogee and perigee.

 3rd. The moon's north and south declination.

 4th. The intervals, called by Dr. Whewell "Lunitidal Intervals," of time between the moon's transits and the succeeding high water ; the extreme intervals caused by the diurnal inequality being faintly marked, and the mean intervals more strongly.

 5th. Wind force and direction at every time of high water ; and

 6th. Barometric pressure at every time of high water.

The graphic presentation of all these elements synchronically enables one to judge better of their influence upon the tide. The diurnal inequality of spring tides is not only shown, but is shown to follow the usual law, as pointed out by Captain Oldham, in connection with the north and south declination of the moon. Equally clearly appears the occurrence of springs at greatest declination, and not at new and full moon, so that at Hobart there is no " *age of the tide* ;" and in connection with this the influence of perigee is shown in the higher tides at south declination. Captain Oldham's caution is very useful while looking at these diagrams that we must remember that we have here only one month's observation. But it is not likely that a year's observations will modify the above-mentioned facts. I believe they will be chiefly useful in showing that there is some regularity in the sequence and circumstances of the great apparent irregularities shown by these observations for one month. To show the nature and extent of these irregularities I have appended two diagrams showing for comparison a fortnight's tide curves at Hobart and a fortnight's at Bombay, and a diagram representing a normal curve of lunitidal intervals in contrast with the zig-zag mean line of such intervals at Hobart. These irregularities will, I think, show that no " *establishment*," that is—time of high water on the day of new or full moon— can be fixed, although on the month's observations Captain Oldham mentions 8h. 15m. At Hobart this is of no great
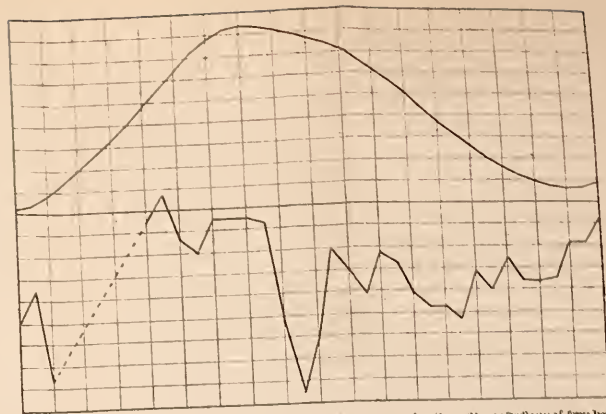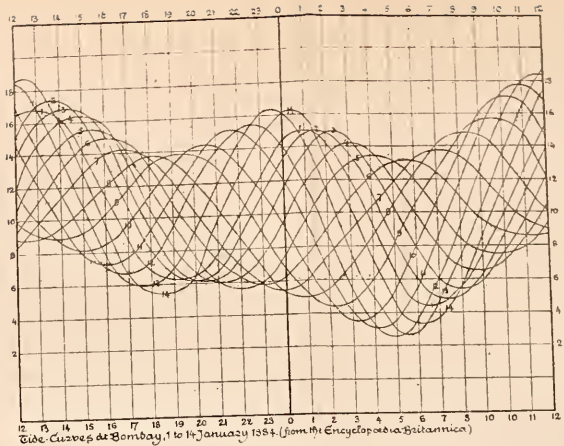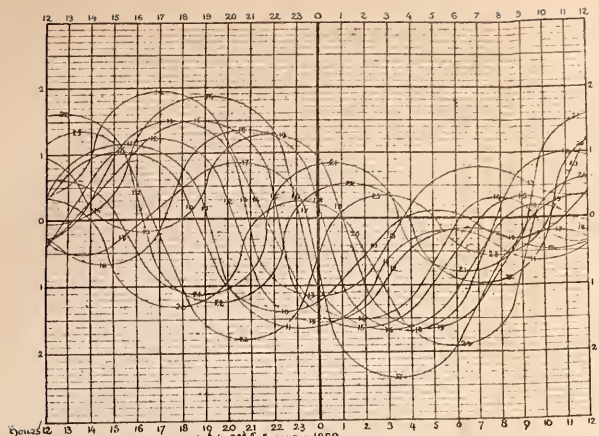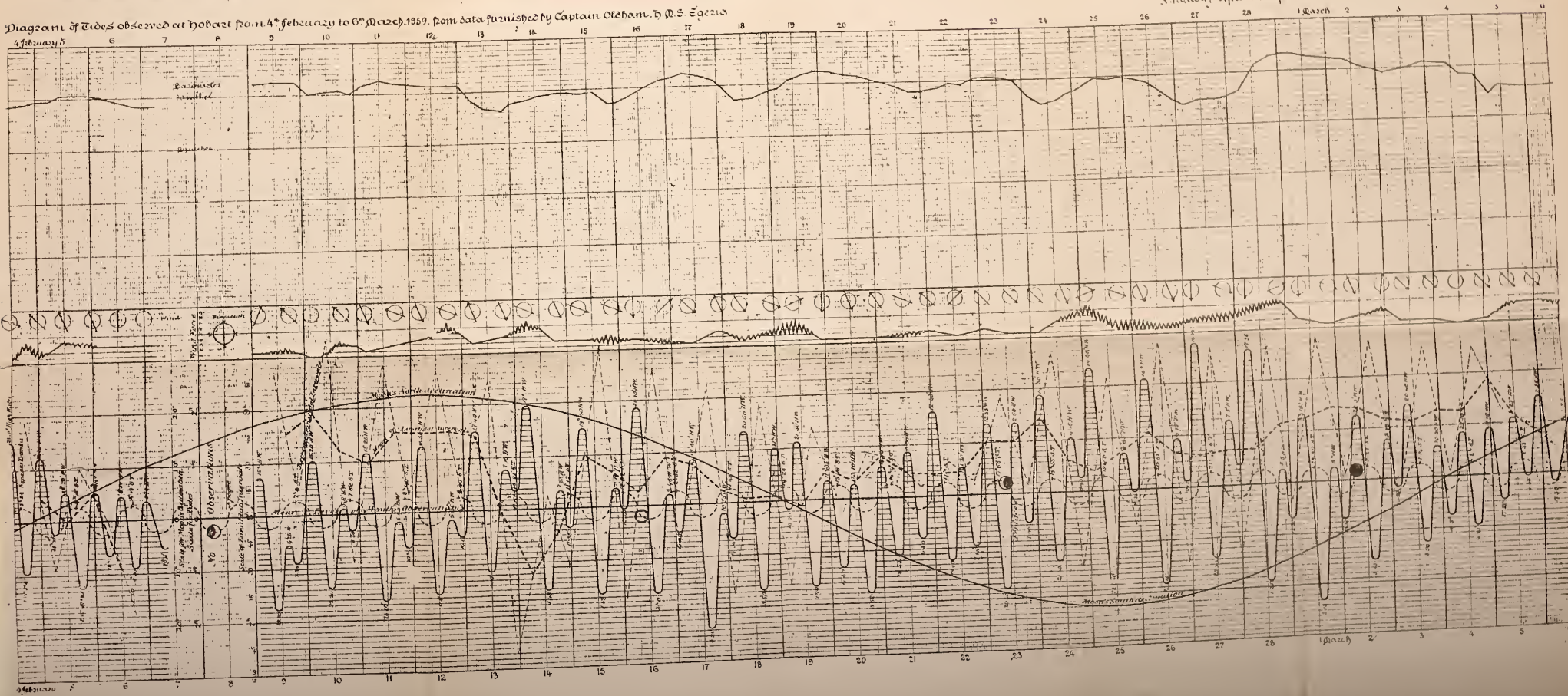
Hours 12 13 14 15 16 17 18 19 20 21 22 23 0 1 2 3 4 5 6 7 8 9 10 11 12
Tide-Curves at Hobart, 10½ to 23ʰ February, 1889.

Tide-Curves at Bombay, 1 to 14 January 1884. (from the Encyclopædia Britannica)

Comparative Luni-tidal Intervals. (Upper curve J⁰. Whewell as sample of regular tides in Admiralty Annual, lower, Hobart)

A. Mault, April, 1889.

Diagram of Tides observed at Hobart from 4ᵗʰ February to 6ᵗʰ March, 1889, from data furnished by Captain Oldham, H.M.S. Egeria.

4 February 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 1 March 2 3 4 5 6

consequence, as the depth of water in the harbour is such that the comparatively small rise and fall of tide does not much affect sailing arrangements.

It is, however, very desirable that the observations to be taken should be as complete as those given by Captain Oldham, and I would press on the Society the desirability of co-operating with the Marine Board to secure this. The importance of the registration of the actual tidal action speaks for itself, and equally so does the necessity of com- paring continually such action with the age and position of the moon. The force and direction of the wind have also an influence that must be noted. In connection with this I may mention that during this month's observations, as shown on the large diagram, the highest tides occurred with the wind blowing from north, and north-easterly points—that is more or less down the Channel. The barometer should also be carefully observed, if a mean sea level is to be fixed, as a fall of one inch in the barometer means a rise of 20 inches in the sea level.

Another important matter can only be secured by the co- operation of the Marine Board;—the progress of the tide wave round the coast. I would suggest that they be asked to get their lighthouse men to keep a register of the actual times of high and low water as nearly as can be ascertained by them during all the time that registers are being kept here. This is a matter of general interest.

I have to apologise to the Society for the presentation of such a meagre paper, but must plead the engrossing nature of my other occupations, and the time that the preparation of the diagrams has taken. But I hope I have said enough to show the desirability of pursuing investigation in this channel.

DISCUSSION.

Mr. A. G. WEBSTER stated that the Marine Board would be willing to render any assistance in its power.

Sir LAMBERT DOBSON said that a namesake of his, who was head-master of the High School, had manufactured an automatic tide gauge himself, and kept a register of tides for some time. He could not say when it was, but he thought it would be about 1853.

Mr. W. E. SHOOBRIDGE stated that at one time he used to register the tide in the Derwent, and found it varied very much, the lowest tides occurring about February and March.

His EXCELLENCY thought it would be very important to have the observations in regard to the tidal wave around the

country. With regard to the point raised by Sir Lambert Dobson, he had been told by fishermen and others that low tides were a sign of fine weather, and high tides of bad weather, and if they had a series of observations extending over some time the value of them in this direction would be seen. He had thought the highest tides would have been experienced when high winds blew in through the Channel, keeping the water up, instead of finding the highest tides when the winds came from the N. or N.E., as Mr. Mault had stated.