

RESULTS OF AN EXAMINATION OF THE RECORDS OF
THE LIVERPOOL SELF-REGISTERING TIDE GAUGE,
FOR THE YEARS 1854, 1855, AND 1856.

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In April, 1855, Lieut. Lord, my predecessor in the office of Marine Surveyor of the Port, read a paper to your Society, giving a full description of the Self-registering Tide Gauges, established by the Liverpool Dock Committee, at Hilbre Island and St. George's Pier-head. These have now been three years in operation, during which time experience has shown the necessity for some minor alterations in the details of their arrangements, which have been carried out under the direction of the Dock Surveyor, and the execution of which prevents my submitting to you an unbroken series of observations. The alterations at Hilbre Island have been the most extensive; and have been so recently completed as scarcely to afford time for a fair comparison of the results from the two stations, which, however, do not present any very material difference. It is probable that several years must elapse before data can be gathered on which to found accurate general conclusions; yet it may be interesting to glance at the more remarkable of the tidal phenomena already chronicled, confining ourselves at present, for the reasons assigned, to the records of the Liverpool gauge.

The diagrams laid upon the table exhibit the daily oscillations of the tidal wave above and below the well-known standard of the Old Dock Sill; while the daily record appended of the general direction and horizontal motion of the wind, and state of the barometer—these particulars being furnished by Mr. Hartnup, of the Liverpool Observatory—indicates the operation of atmospheric influences upon the tidal action. It will be seen that lapses in the series of observations have been endured at different seasons and for unequal periods in the several years treated of, which will account, to a certain extent, for apparent inequalities in the annual result; but, while slight inequalities may perhaps be anticipated, it will be found

that through the ever-changing aspect of tidal action, and atmospheric influence, each year producing some singular discrepancies, a constant mean exists, from which the annual variation will probably prove eventually to be almost inappreciable.

Our records extend, in the three years under discussion, to the number of tides, as follows—in 1854, 663; in 1855, 678; in 1856 to 651 tides. An annual course complete would comprise about 706 tides. Taking, then, the records of these tides, and the level of the Old Dock Sill for a point of comparison, we obtain the following means—

YEAR.	MEAN OF HIGH WATER ABOVE O.D.S.	MEAN OF LOW WATER BELOW O.D.S.	RANGE OF TIDE.	MEAN LEVEL ABOVE O.D.S.
1854	15.424 feet	5.544 feet	20.968 feet	4.940 feet
1855	15.425 "	5.570 "	20.995 "	4.928 "
1856	15.515 "	5.449 "	20.964 "	5.033 "
Mean of means	15.455 "	5.521 "	20.976 "	4.967 "

YEAR.	ORDINARY SPRING TIDES.			NEAP TIDES.		
	MEAN OF HIGH WATER ABOVE O.D.S.	MEAN OF LOW WATER BELOW O.D.S.	RANGE.	MEAN OF HIGH WATER ABOVE O.D.S.	MEAN OF LOW WATER BELOW O.D.S.	RANGE.
1854	18.985 feet	8.611 feet	27.596 feet	11.698 feet	1.394 feet	13.092 feet
1855	18.388 "	8.194 "	26.582 "	11.527 "	1.438 "	12.965 "
1856	18.503 "	8.166 "	26.669 "	11.641 "	1.315 "	12.956 "
Mean of means.	18.625 "	8.324 "	26.949 "	11.622 "	1.382 "	13.004 "

From the above, the mean level for ordinary spring tides, for the three years, is respectively, 5.187 feet, 5.097 feet, and 5.169 feet; and for neap tides, 5.152 feet, 5.945 feet, and 5.163 feet above the Old Dock Sill; giving as the mean of means 5.135.

The highest tidal level attained in each year occurred
 in 1854—29th January, at 11-45 a.m., wind from W., and strong gale,
 21 feet above O.D.S. ;
 in 1855—25th October, at 11-30 p.m., wind from W., and strong gale,
 21 feet 9 inches ;
 in 1856—16th October, at 0-15 a.m., wind from W.N.W., and strong gale,
 22 feet 11 inches ;

and the lowest tidal level below the standard occurred

in 1854—8th Sept., at 6-45 a.m., wind Easterly and light, 10 ft. 8 in.

in 1855—20th Jan., at 7-45 p.m., wind do. moderate, 10 ft. 8 in.

in 1856—8th March, at 7-45 p.m., wind N.N.W. and light, 11 ft. 11 in.

giving the extreme range for each year—

1854.....31 feet 8 inches,

1855.....32 „ 5 „

1856.....34 „ 10 „

It will be observed that the highest tides by no means denote the greatest range of tide, since it appears as if on those occasions the extraordinary rise were due to a general elevation, from atmospheric or other causes, of the sea level over which the tidal wave traverses ; thus the greatest range of a tidal wave occurred in each year as follows—

In 1854, on the 28th of February, 30 feet 7 inches from low to high water of the same tide, the high water at 0-15 a.m. attaining the level of only 20 feet 2 inches above O.D.S.

In 1855, on the 25th of October, the range was 29 feet from low to high water of the same tide, the high water at 11 a.m. 19 feet 10 inches above O.D.S., this being the tide preceding that which in the evening of the same day attained the highest level of the year; but the general elevation of the sea level having prevented the ensuing low water from receding to its previous level, the p.m. tide, though rising nearly two feet higher, did not attain the range of the morning tide.

In 1856, on the 6th of April, the range was 32 feet 5 inches from low to high water of the same tide, the high water at 0-10 p.m. 22 feet 5 inches above O.D.S.

The lowest high water levels in each year were—

in 1854, on 15th October, at 5-30 a.m., 9 feet 3 inches above O.D.S.

in 1855, on 25th April, at 6-30 p.m., 10 „ 1 „ „

in 1856, on 15th March, at 6-15 a.m., 9 „ 6 „ „

and the least range of the tidal wave was in 1854, on 15th October, coinciding, in this instance, with the lowest high water level, from high to low water, 7 feet 9 inches; in 1855, on the 27th March, from low to high water at 7-15 p.m., 8 feet 8 inches; and in 1856, on the 8th October, at 5 a.m., from high to low water, 10 feet 2 inches.

In conclusion, it may be useful to see how far the registered results coincide with the calculated and predicted heights of tides, taking for this purpose those tides when high water occurs between 6 a.m. and 6 p.m., being those to which the calculation of Holden's Tables refer.

We have the actual height in excess of predicted height, in 1854, on 231 occasions; in 1855, on 244; and in 1856, on 264.

The height has been less than predicted, in 1854, on 112 occasions; in 1855, on 95; and in 1856, on 64.

And the actual and predicted heights have agreed, in 1854, on 22 occasions; in 1855, on 15; and in 1856, on 11.

The greatest differences between the registered and predicted heights occurred as follows:—

HEIGHT IN EXCESS OF PREDICTION.

Feb. 17th, 1854—2 feet 8 inches, wind W.N.W. strong gale.
 March 3rd, 1855—2 „ 11 „ wind N.W. moderate gale.
 Jan. 22nd, 1856—2 „ 11 „ wind Easterly, moderate.

HEIGHT LESS THAN PREDICTED.

April 1st, 1854—2 feet 6 inches, wind S.W. moderate.
 Dec. 19th, 1855—2 „ 9 „ wind S.E. strong breeze.
 July 22nd, 1856—1 „ 6 „ wind N.W. light breeze.

STATE OF BAROMETER.

Max.	Min.
1854, Oct. 12th, 30.587 inches.	Jan. 7th, 28.762 inches.
1855, Jan. 12th, 30.669 „	Dec. 25th, 28.920 „
1856, Nov. 24th, 30.936 „	Jan. 24th, 28.759 „

HORIZONTAL MOTION OF WIND.

Max.	Min.
1854, Feb. 18th, 1039 miles.	Feb. 12th, 89 miles in 24 hours.
1855, Jan. 1st, 974 „	Jan. 11th, 77 „ „
1856, Nov. 24th, 879 „	Nov. 1st, 77 „ „