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curves a negative deflection, becomes in the later ones a positive deflection. The latter, on further lengthening of the duration of light, gradually increases in size. In the conflict between negative and positive deflections, there is sometimes seen an upward movement, which is immediately preceded by a small downward one.

Of the various particularities which occur in the course of the experiments we shall only briefly mention the latent period. The duration of this period is dependent to so high a degree upon the intensity of the illumination, that it is possible to some extent to judge of the intensities of light used by previous observers from the latent periods recorded by them. With very weak lighting there appear latent periods of the second substance which may exceed two seconds.

In opposition to GOTCH and GARTEN WALLER[1]) also mentions latent periods as large in amount as we have observed and others much larger, but as WALLER in his experiments made use of a slow THOMSON galvanometer, there remained the possibility that there were two opposite forces which at first neutralised one another and then after an interval one obtained the mastery. The forces assumed by WALLER agree with our first and second substances.

A more detailed description of our experiments accompanied by a reproduction of some of our curves will appear elsewhere.

Geophysics. — "*The height of the mean sea-level in the Y before Amsterdam from* 1700—1860". By Prof. H. G. VAN DE SANDE BAKHUYZEN.

Our section has been engaged in former years with an investigation of the subsidence of the land in the Netherlands, and it is especially to Dr. F. J. STAMKART, member of the committee for that investigation, that we owe several important communications on this subject.

Twenty years ago, when calculating the results of the precise levelling, I made some computations in order to determine the subsidence of the land but have not published them. The interesting paper on this subject of Mr. RAMAER, head-engineer, director of the hydrographic survey, has now induced me to re-examine my former notes and as they perhaps may contribute towards the solution of the problem, whether the land under Amsterdam has subsided since

1) AUGUSTUS D. WALLER, Philosoph. Transact. of the Royal Soc. of London, Ser. B, vol. 193, p. 123, 1900.

1700, I intend to publish them here as a continuation to the earlier reports of the "Comittee for the subsidence of the land."

My results have been chiefly derived from the heights of the water in the Y before Amsterdam, recorded from 1700 to 1860 at each hour of the day and at each half hour during the night in the town's tidal station situated at the present fishmarket near the "Nieuwe Markt." Part of them occur in two communications of STAMKART (Verslagen en mededeelingen der Kon. Akad. van Wetenschappen Afd. Natuurkunde, 15e deel 1863, p. 59—69 and 17e deel 1865, p. 261—303) and some in STAMKART's posthumous papers in keeping of the Academy.

The way in which these observations were made is described as follows by Dr. STAMKART in his paper in Vol. XVII p. 273. The tidal station was erected above the water; in the wooden floor of one of the rooms was a hole through which a gauging rod carrying a mark of the A.P. (zero of Amsterdam) was plunged vertically into the water so far until a notch of the rod caught on the wooden floor. The height to which the gauging rod was wetted showed the level of the water with regard to the zero on the gauge.

In order to draw reliable conclusions about the level of the Northsea on our coast based on the results of the water-level in the Y, it is necessary to investigate whether during the period under consideration variations have occurred in the influx and the outflow of the water of the Y before Amsterdam, owing to changes in the depth and width of the canals leading from the Northsea to the Y. It is very probable that these variations may produce opposed effects on the high and the low water and hence give rise to greater variations in the difference between high and low water than in the mean sea level. The variations of these differences in the succeeding years will therefore be a good standard of the changes in the canals.

From the tide tables of the town's tidal station we derive the following differences between high and low water during 58 years.

TABLE I.

Year	Difference between high and low water	Year	Difference between high and low water	Year	Difference between high and low water	Year	Difference between high and low water
1700	309 mm.	1715	222 mm.	1805	303 mm.	1847	303 mm.
1701	323 „	1716	299 „	1806	342 „	1848	309 „
1702	331 „	1717	342 „	1807	345 „	1849	318 „
1703	320 „	1725	327 „	1808	331 „	1850	322 „
1704	320 „	1749	318 „	1809	327 „	1851	324 „
1705	312 „	1775	328 „	1810	338 „	1852	329 „
1706	319 „	1796	318 „	1811	330 „	1853	319 „
1707	314 „	1797	313 „	1812	316 „	1854	320 „
1708	308 „	1798	302 „	1813	323 „	1855	287 „
1709	286 „	1799	287 „	1825	341 „	1856	314 „
1710	318 „	1800	288 „	1843	325 „	1857	317 „
1711	325 „	1801	327 „	1844	313 „	1858	295 „
1712	332 „	1802	321 „	1845	310 „	1859	328 „
1713	322 „	1803	284 „	1846	328 „	1860	332 „
1714	332 „	1804	323 „				

If we assume that in each of the 3 periods of 18 years this difference has been constant, we find for it:

in the 1st	period	1700—1717	319 mm.
„ „ 2d	„	1796—1813	318 „
„ „ 3d	„	1843—1860	316 „

The mean error of a yearly mean is then ± 14,8 mm.

If we suppose that from 1700—1860 the difference has remained constant, then the difference derived from all the 58 years amounts to 318 mm. and the mean error of a yearly mean to ± 14.4 mm. Therefore we are justified in assuming that the difference has remained constant during the whole period 1700—1860 and was 318 mm. ± 1,9 mm.

Moreover we derive from this table that between 1700 and 1860 no perceptible change has occurred in the influx and outflow of the water from the Northsea to the Y, no more than in the mean level of the Northsea with regard to the mean level of the Y.

As mean level of the Y before Amsterdam with regard to the zero adopted in the tidal station (zero of Amsterdam) we shall assume the half sum of the high and low water.

For the same 58 years we derive for that mean the following values.

TABLE II.

Year	Mean Sea level above A.P.	Year	Mean Sea level above A.P.	Year	Mean Sea level above A.P.	Year	Mean Sea level above A.P.
1700	— 172 mm.	1715	— 166 mm.	1805	— 105 mm.	1847	— 79 mm.
1701	„ 169 „	1716	„ 163 „	1806	„ 69 „	1848	„ 102 „
1702	„ 148 „	1717	„ 159 „	1807	„ 69 „	1849	„ 64 „
1703	„ 187 „	1725	„ 154 „	1808	„ 147 „	1850	„ 53 „
1704	„ 146 „	1749	„ 134 „	1809	„ 112 „	1851	„ 66 „
1705	„ 179 „	1775	„ 89 „	1810	„ 90 „	1852	„ 59 „
1706	„ 199 „	1796	„ 84 „	1811	„ 99 „	1853	„ 76 „
1707	„ 160 „	1797	„ 115 „	1812	„ 103 „	1854	„ 12 „
1708	„ 153 „	1798	„ 96 „	1813	„ 114 „	1855	„ 76 „
1709	„ 193 „	1799	„ 136 „	1825	„ 51 „	1856	„ 48 „
1710	„ 167 „	1800	„ 134 „	1843	„ 20 „	1857	„ 101 „
1711	„ 144 „	1801	„ 55 „	1844	„ 15 „	1858	„ 96 „
1712	„ 126 „	1802	„ 123 „	1845	„ 54 „	1859	„ 64 „
1713	„ 149 „	1803	„ 132 „	1846	„ 40 „	1860	„ 75 „
1714	„ 106 „	1804	„ 92 „				

These values show that the mean sea level has not remained unchanged with regard to the adopted zero of Amsterdam. This becomes still more evident if we form the means of the 3 periods of 18 years. We then obtain:

1708,5	—160,3 mm.	±	5,9 mm.
1725	—154 „	±	25,1 „
1749	—134 „	±	25,1 „
1775	— 89 „	±	25,1 „
1804,5	—104 „	±	5,9 „
1825	— 51 „	±	25,1 „
1851,5	— 61 „	±	5,9 „

If we suppose that during each of the periods of 18 years the mean sea level has remained unchanged we derive from the deviations of the yearly means from the mean of 18 years a mean error for each year of ± 25,1 mm. and in the mean of 18 years a mean error of ± 5,9 mm.

If on the contrary we suppose that during each of the periods of 18 years the mean sea level with regard to the adopted Amsterdam zero has varied proportionally to the time, we get for the mean error of the yearly mean ± 24,3 mm. and for the yearly variations:

from 1700—1717	+ 1,57 mm.	± 1,10 mm.	
„ 1796—1813	+ 0,14 „	± 1,10 „	
„ 1843—1860	— 2,30 „	± 1,10 „ .	

Hence in the 1st and 2nd periods, in agreement with the general variation of the mean sea levels from 1700—1826, the mean sea level has apparently come nearer to the adopted A.P., but has retired thence in the 3d period in agreement with the variation from 1825—1851,5. Nevertheless the mean errors of each of these yearly variations, ± 1,10 mm., are so large with regard to the variations themselves, that we attach only a very small weight to the values found; only to the yearly variation in the 3d period, more than twice the value of the mean error, we may attach a somewhat larger weight. If we adopt a uniform yearly variation between the years 1708,5 and 1804,5, this would amount to 0.58 mm.; in good harmony with this are the results for 1725 and 1749, but the result for 1775 shows a deviation of 32 mm.

We conclude that the elevation of the adopted A.P. above the mean sea level has gradually varied and that the variations can be considered as partly proportional to time; they cannot however be derived exactly from the observations.

The elevation of the A.P. in the tidal station above the mean sea level *in the first and the last year of the series of observations*, 1700 and 1860, are according to table II 162 mm. and 75 mm. each with a mean error of ± 25 mm. In order to obtain for these elevation values with a smaller mean error, we may use, upon supposition that no sudden variations have taken place in the zero of the gauging rod, the elevation observed in closely preceding or following years, which must be reduced to the year 1700 or to 1860 with an adopted yearly variation. Because the yearly variation is not known with great precision, as appeared above, it is desirable that these years should not be at a great distance from 1700 or from 1860; therefore

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I have confined myself to the mean of the 5 years 1700—1704 and 1856—1860. To these means we must add the variations during a period of two years, which are probably smaller than 3 mm. and 5 mm. the values which would follow from the periods of 18 years; instead of these I adopt 1 mm. and 4 mm. and consequently:

adopted A.P. above mean sea level in 1700 = 164 + 1 = 165 mm.
„ A.P. „ „ „ „ „ 1860 = 76 + 4 = 80 „

For the mean error of these values I have derived ± 12 mm.

As yet it remains undecided whether the variation from 165 mm. to 80 mm. is due to a slow variation in the mean level of the North sea on our coast, or to a variation of the adopted A P. in the tidal station either caused by the sinking of the whole station or of the wooden floor, or by accidental or perhaps intentional changes in the height of the A.P. on the gauging rod which during the period from 1700 to 1860 has certainly been renewed several times.

Some data towards the solution of this dilemma may be borrowed from the elevations of the bench marks in the 5 sluices: Oude Haarlemmersluis, Nieuwebrugsluis, Kraansluis, Westindischesluis and Kolksluis; these bench marks have been established in 1682, and consist of grooves cut in stones indicating the elevation of the A.P. The good mutual agreement between the heights of the grooves in the year 1875 which appeared from the levelling made by our member Dr. Lely (the largest difference between them amounted to only 8 mm.) proves that those grooves have been placed with the greatest care, and makes us confident that in 1700, when the first observations in the tidal station were made, the zero on the gauging rod agreed well with that on the stones placed in the sluices some years earlier.

We are therefore entitled to assume with a high degree of probability that in 1700 the A.P. on the 5 sluices was 165 mm. above the mean level of the Y.

In 1860 Stamkart by a levelling has compared the height of the A.P. in the tidal station at that time with the heights of two bench marks in the tower of the St. Anthoniewaag. He found:

lower bench mark 3208,4 mm. above A.P. in the tidal station
higher „ „ 3705,4 mm. „ „ „ „ „ „

In the same year Dr. Stamkart and Mr. v. d. Sterr have also determined by means of levelling the difference in height between the higher bench mark in the St. Anthoniewaag and the grooves in the 5 sluices (Versl. en meded. XVII p. 277—284). From these observations we derive the following values for the height of the higher bench mark above the A.P. according to the mean of the 5 sluices in 1860:

STAMKART	v. d. STERR	mean
3628 mm.	3624 mm.	3627 mm.

In the derivation of the mean value we have, with regard to the mean errors, accorded a greater weight to STAMKART's result.

In 1875 our colleague Dr. LELY by means of a still preciser levelling under direction of COHEN STUART has derived 3622 mm. for the same difference in height.

The differences between the results of 1860 and those of 1875 may be explained very well by errors of observation, so that we may accept with a high degree of accuracy that the bench mark in the St. Anthoniewaag between 1860 and 1875 has not varied with regard to the 5 sluices and that in 1860 the height of the mark above the A.P. of the sluices was 3623 mm. with a mean error of $\pm$ 2 mm.

If from this value we subtract 3705, i. e. the height of the mark above the A.P. in the tidal station found by Dr. STAMKART in 1860 we find:

height of the A.P. according to the mean of the 5 sluices above the A.P. in the tidal station in 1860 = 82 mm.

The mean error of this result is about $\pm$ 3 mm.

As in 1860 the height of the A.P. in the tidal station was elevated 80 mm. above the mean level of the Y, it follows that in 1860 the A.P. derived from the mean of the 5 sluices above the mean sea level is:

$$80 + 82 = 162 \text{ mm.} \pm 13 \text{ mm.}$$

If we compare this value with the corresponding value of the year 1700, i. e. 165, we may conclude that the height of the mean sea level in the Y, and hence the mean level of the Northsea on our coast has not perceptibly varied with regard to the ground in which the foundations of the 5 sluices are built.

The uncertainty of this conclusion may be expressed by a mean error of $\pm$ 18 mm.

The 5 sluices are not in close neighbourhood of each other, the extreme ones are separated by a distance of one kilometre; hence it is over a fairly extensive part of the ground on which Amsterdam is built that the level of the land with regard to the level of the Northsea has remained unchanged during more than one century and a half.

With the same degree of probability with which we have derived this invariability we may derive from the observations the subsider of the A.P. in the tidal station with regard to the A.P. derived frc the marks in the 5 sluices, amounting to 165—80 = 85 mm. betwe 1700 and 1860.

The method by which the height of the water in the tidal stati was obtained and the possible causes of the subsidence of the zero on t rod added to the invariability of the 5 grooves in the sluices and hence a fairly large part of the ground of Amsterdam with regard the sea, render the idea very probable that this subsidence has a pu local character and that we are not entitled to derive any results wi regard to the subsidence of a larger part of the ground of Amsterdai

It has often been asked what the Amsterdam zero represen Our colleague Dr. VAN DIESEN has devoted to this subject interesting study in which he has gathered from old documen everything which may help us to find how this zero has bee established. With certainty nothing can be derived from it. B the observations show: 1 that in 1700 the A.P. was 165 mm. 12 mm. above the mean sea level in the Y, 2 that the height of tl mean high water was $\frac{318}{2} = 159$ mm. ± 1 mm. above the same mea sea level, and we conclude thence that both in 1700 and 1860 th A.P. within the limits of the errors of observation agreed with th mean high water in the Y.

Astronomy. — "*On the masses and elements of Jupiter's satellite and the mass of the system* (continued), by Dr. W. DE SITTE (Communicated by Prof. J. C. KAPTEYN).

III. *The great inequalities.*

The values of these, derived from the heliometer-observations 1891, 1901 and 1902, have been collected in Table III, togethe

TABLE III. GREAT INEQUALITIES.

Authority	x_1	x_2	x_3
1891	0°.509 ± 0°.018	1°.021 ± 0°.013	0°.059 ± 0°.007
1901	0.481 ± 47	1.089 ± 30	0.049 ± 20
1902	0.372 ± 34	1.171 ± 19	0.034 ± 12
DAMOISEAU	0.455	1.074	0.073
SOUILLART's theory	0.432	1.026	0.063
Masses (*C*)	0.430 ± .020	0.988 ± .017	0.064 ± 003